BRIEF INTRODUCTION TO THE SERIES

COMMUNITY, ENVIRONMENT AND DISASTER RISK MANAGEMENT

This series connects academic research to field practice, strengthening the links between the environment, disaster, and community. The series will be developed on field evidences and community practices, and thus will provide specific guides to professionals who are grounded in rigorous academic analysis. The series will have specific focus on community-based disaster risk management, urban environmental management, human security, water community, risk communication, climate change adaptation, climate disaster resilience, and community-based practices.

BRIEF INTRODUCTION TO THE VOLUME

In spite of increased investments in the area of disaster management in recent decades, the losses continue to mount. One of the emerging reasons for the current trend of increasing impacts of disasters is the unpredictability of natural hazard events coupled with the tendency of human settlements to move to vulnerable locations including coastal areas in search of economic gains. The urban areas are naturally the most affected due to concentration of habitat and resources. In the current context, it is impossible to make resistant urban growth. Instead, resilience is becoming more widely accepted, where certain vital infrastructures need to be resistant, but the urban systems need to be resilient enough to cope with the climate-related hazards. This book highlights the issues of resilience through regional, national, city- and community-based studies. The book shows how to enhance actions at local levels, and how the plans can be implemented through multistakeholder collaboration.

PREFACE

Due to changes in climatic conditions, hydrometeorological hazards are increasing. Cities are becoming more vulnerable due to usual urban issues, and additional pressure of climate-related hazards. While it is rather impossible to make a city resistant, urban resilience is the possible entry point for dealing the new types of hazards. Keeping this in mind, this book provides a unique series of examples of climate and disaster resilience initiative, which focuses on the different dimensions of city's resilience. Evolved through a participatory approach, the book exemplifies innovations in redefining city's resilience in a way, which is closely linked to city services. Analyzing the cities resilience through five dimensions of physical, social, economic, institutional, and natural, the Climate and Disaster Resilience Initiative (CDRI) focuses on detailed analysis on city or subcity level. CDRI is considered as a tool, as well as a process to enhance the city resilience through steps of assessment, planning, and implementation.

CDRI was developed over last three years with the participation of researchers, practitioners, and city managers. The funding came from the Global Center of Excellence (GCOE) "Human Security Engineering of Asian Megacities (HSE)" of Kyoto University. This is highly acknowledged. CDRI's capacity-building program was jointly funded by GCEO–HSE and Tokyo Development Learning Center (TDLC) of the World Bank. Through this process, strong collaboration was obtained from the city governments, and other university partners; and this is also highly acknowledged.

Finally, the purpose of this book is to provide an academic analysis of the whole process of development and implementation of CDRI, and to emphasize the city-based action planning and implementation. Needless to say, there is scope of further improvements and refinements of the methodology. This book provides the opportunity to the readers to understand the philosophy and methodology of the city based resilience analysis. We will be delighted if the readers consider the book useful.

Rajib Shaw
Anshu Sharma
Editors

CLIMATE AND DISASTER RESILIENCE IN CITIES

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COMMUNITY, ENVIRONMENT AND DISASTER RISK MANAGEMENT VOLUME 6

CLIMATE AND DISASTER RESILIENCE IN CITIES

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CHAPTER 1

OVERVIEW OF URBAN DEVELOPMENT AND ASSOCIATED RISKS

Anshu Sharma, Akhilesh Surjan and Rajib Shaw

BACKGROUND

Climate change is happening now. Climate-induced disasters are occurring in the Asia Pacific region, where a distinctly increasing trend has been observed in recent decades. This shows that the region is the most disaster prone, compared with other parts of the world. Studies on the causes of disaster in many affected regions suggest that in a typical disaster, cities with high population density see increases in mortality and number of people affected. Increased economic losses within the region are also inevitable. In most Asian countries, 65–90% of economic activities are concentrated in urban areas. Estimates indicate that two out of three people on the earth will live in urban areas by the year 2030. Unless appropriate measures are taken in these urban communities, disaster incidents will continue to increase. Urban communities are a main player to confront this increasing trend of climate-induced disasters.

Past experiences have shown that local governments and local institutions are the first respondents, as they are geographically close to the local communities. Thus, it is vitally important to undertake integrated disaster risk reduction approaches and disaster risk management at the local level, in

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order to maximize effective action. It is crucial for urban communities to be the main stakeholders to plan and implement action, and to lessen the impact of climate-induced disasters on human life, natural and human systems, diversity and functions of ecosystems, livelihoods, and economic losses.

> With more than half of the world's population now living in urban areas, this is the urban century. Cities embody some of society's most pressing challenges, from pollution and disease to unemployment and lack of adequate shelter. But cities are also venues where rapid, dramatic change is not just possible but expected. Thus they present real opportunities for increasing energy efficiency, reducing disparities in development and improving living conditions in general.
>
> – Ban Ki Moon, 2008, State of the world's cities 2008/2009. UN-Habitat

UNDERSTANDING UNDERLYING RISK WITHIN THE URBAN GROWTH PROCESS

Mainstreaming of risk reduction within the urban planning and development process is nonnegotiable since the emergence of risk is engrained in the city's very inception. When populations migrate to a new location and settle in unfamiliar settings with aliens due to economic reasons, their physical as well as social risk levels rise. Such settlements take place in areas not inhabited earlier, and are often in locations of high hazard exposure, such as riverbanks, transportation interchanges, mining or industrial hubs, or other such centers of high turnover, high traffic, and high risks. Removed from their traditional social safety nets, the urban settlers do not have much to fall back upon in times of crisis. This is particularly true for the urban poor, who live in marginal settlements, in substandard housing, with limited infrastructure and services, and with very little assets. Given urban areas' high population densities, including high concentrations of vulnerable people, increasing urban disaster risks are key concerns in discussions of the adverse impacts of climate change (Sluis & Aalst, 2006).

Cities are growing naturally, through migration, and through redesignation of rural areas as urban. Whichever the method, cities are growing faster than ever, and the larger a city, the faster it grows. Within this growth, insensitive or noninclusive urban land-use planning, and urban development and management, all lead to the creation of higher risk levels. These processes in most Asian cities are based on a master plan approach that does not pay adequate attention to the urban poor and the informal sector, does not include local people in the processes, and depends on

projection-based planning for unrealistic horizons instead of attempting to get close to real-time planning.

Most of the world's poor live in developing countries with rapidly growing populations, where poverty and population growth are reinforcing each other (Brown, 2001). Burdens of population coupled with a host of other reasons are resulting in the growth of cities at an unprecedented pace. As there is lack of space to expand, cities are getting denser and are growing vertically. People are now building, living, and working on lands that were earlier unoccupied because they were hazard prone, like steep slopes, low-lying lands, floodplains, riverbeds, and drains. At the same time, human actions especially prevailing in the developed parts of the world since last two centuries or so are now causing warming of the globe and creating risk for all areas in general, and for mountain, riverine, and coastal habitations in particular, in an irreversible manner.

By their very nature of population concentrations and developmental densities, urban areas give birth to risk. Physically, the structures and infrastructure increase risk due to informal nature of construction, densities, etc. Socially, the safety nets of closely knit communities are lost and in fact conflicts between unrelated communities increase. Similarly, we can trace environmental degradation, unhealthy living conditions, and other factors accumulating risks, and more importantly the weakening of resilience.

Urbanization: The Price of Gains

> Slum-dwellers now number a billion, but the rush to cities continues. A billion people live in lagging areas of developing nations, remote from globalization's many benefits. And poverty and high mortality persist among the world's "bottom billion," trapped without access to global markets, even as others grow more prosperous and live ever longer lives.
>
> Reshaping Economic Geography reframes debates to include all the instruments of integration – spatially blind institutions, spatially connective infrastructure, and spatially targeted interventions. By calibrating the blend of these instruments, today's developers can reshape their economic geography. If they do this well, their growth will still be unbalanced, but their development will be inclusive.
>
> – World Development Report (WDR), 2009

Cities grow throughout their life spans, growing faster as they become bigger. The city center keeps getting more and more densely populated, and turns into a concrete jungle of chaos. The "rural-urban fringe" constantly gets consumed as the cities grow, and these peri-urban areas along with small emerging towns are a cause of concern since they grow in an ad hoc

manner, leading to substandard living conditions, eventually getting subsumed in the city. These emerging urban areas throw up many challenges for risk reduction work.

While ''urban growth'' is the process of absolute growth in the size of an urban area or population, ''urbanization'' is the process wherein a larger portion of the population starts living in urban areas. Urbanization can be the result of natural growth of the urban population, migration from rural to urban areas, and reclassification of rural settlements to urban. The result of all these processes is the accumulation of stresses, and thus risk, in various forms and at different levels.

Megacities: Bursting at the Seams

The megacities in the region (population more than 10 million) are the most visible hotspots of risk. They have mostly emerged from metropolitan cities with high economic momentum, thereby leading to a wide-ranging economic base and resultant land-use pattern. Most megacities exist in the form of urban agglomerations, wherein a number of adjoining smaller settlements, previously the main city's satellite towns, are now part of the large urban continuum.

Small Towns: Below the Radar, but Ticking

Though small and medium towns constitute a very large percentage of the total number of urban settlements in the region, a major portion of investments in the cities is hogged by the megacities and metropolitan cities, leaving the small towns with meager resources to plan, develop, and maintain their infrastructure. An indicator of the dismal status of planning for the small and medium towns is the status of their development plans. The Master Plan is the core document that guides the development of a city in the urban planning system. Yet a large number of cities in the region do not have any Master Plans, and base maps. Due to the emergence of satellite imagery, physical attributes can now be mapped for these towns, but the ground verification and usage data is of dismally low quantity and quality. Where Master Plans exist, they have proved grossly inadequate to guide urban development since they are largely limited to land-use planning and oblivious to the socioeconomic and geopolitical realities of cities, are for unmanageably long horizon periods (usually 20 years, within which many

ground realities change drastically), and are prone to high jacking and abuse by political and commercial vested interests.

In such realities, the citizens of small towns live a life that is full of allurements of urban jobs and lifestyles, but bereft of locally available opportunities, and riddled with poor roads, power supply, public health and hygiene, and other physical and social infrastructure. One of the most critical problems faced by these settlements is of water and sanitation.

Peri-Urban: The "Fringe"

Peri-urban literally means on the fringe of a city. Cities grow in size. The bigger a city, the faster it grows. As it grows, it consumes rural lands around it. Land that is on the outskirts of a growing city undergoes significant transformation, and so do the lives of the people living in such areas. While some of the transformations are beneficial, and bring the conveniences and wealth of urban life, others can be equally detrimental to the quality of life. Such areas, earlier also known as the rural–urban fringe, are called peri-urban areas.

While city governments are unable to provide for this surge of population, the rural areas just outside the city start cashing in on the demand for products, services, and land for the growing informal economy. Given the fact that most of the thousands of cities in the region are undergoing such a growth, the magnitude of peri-urban lands and populations undergoing resultant good and bad transformation is phenomenal. Unfortunately, almost all of this transformation falls under the category of "growth" and not "development." It is random, ad hoc, unplanned, highly polluting, based on economic opportunities that are unequally distributed, and irreversible.

URBANIZATION AND RISK IN THE ASIA PACIFIC REGION

Asia Pacific Cities at Risk

The natural disaster incidences in the Asia Pacific region have demonstrated a distinctly increasing trend over recent decades. The region experiences some of the world's worst natural hazards – frequent earthquakes, volcanic eruptions, cyclones, and annual monsoons. It also includes many of the world's megacities – those with more than 10 million people – so the number of people exposed to risks in the region is very high. Moreover, disasters are

increasing in number and size every year due to a number of factors including rapid population growth, urbanization, and climate change. It seems inevitable that the Asia Pacific region will see one or more "mega-disasters," seriously affecting millions of people, during the 21st century. Some researchers have predicted that an earthquake with a million fatalities could occur in the Himalayan belt of South Asia and one can argue that megacities in China, Indonesia, and the Philippines are also candidates. In addition, population explosion in the mega-deltas and coastal areas of Asia, combined with increasing vulnerability to climate change, indicates that a flood, cyclone, or tsunami event affecting tens of millions of people is also likely. The fast growing cities of the Asia Pacific region are at very high risk.

The underlying reasons for this high risk are rooted in the very process of rapid urbanization, which in turn is increasingly exerting such a tremendous pressure on land that it is causing communities to squat on environmentally unstable areas such as steep hillsides prone to landslide, by the side of rivers that regularly flood, next to the coasts that threaten storm surges, or on unstable ground that is prone to subsidence. Thus, urban communities are increasingly living in high-risk conditions, being exposed to disaster events such as floods, earthquakes, collapsing buildings, fires, and even the virtual collapse of civic infrastructure services. In most cases, the brunt of such events is borne by the economically weaker sections of the community. There is also the insidious risk, often ignored, of continuing disaster: of communities maintained in poverty by the constant setback of ongoing disasters. Such events damage lives and livelihoods, perpetuating long-term poverty, and ultimately undermine any effort to improve vulnerable urban settlements that hope to be sustainable. Long-term reduction in vulnerability can be achieved with the adoption of practical and community-centered risk mitigation measures within existing urban planning practices.

Yet the adoption of risk reduction measures is not even considered in local-level planning practices. It has traditionally been perceived as a separate discipline, usually not associated with mainstream urban planning. There is thus an urgent need to identify urban risk in the Asian region, particularly in its coastal cities, and use good practices from within the region to find a way forward for reducing urban risk. The efforts to undertake such risk reduction measures will need to be based on a sound understanding of the urban scenario, urbanization trends, and the risk profile of the region. Since the Asia Pacific is the most densely populated region of the world, the fastest growing, and the most hazard prone, it is one of the most "at risk" parts of the world, and its cities the hubs of this risk. The distribution of some of the major cities in Asia seen in the context of the

natural hazard of the region gives a glimpse of the threat under which the urban population of the region is living. It can also be seen from various sets of information that urban settlements are conglomerating near riverine and coastal areas. The coastal concentrations are at an increased risk of storm surges, tsunamis, and sea-level rise in the present context of climate change.

Asia: The Epicenter of an Urban Surge

In absolute numbers, Asia is the epicenter of the current urbanization surge where some 1.1 billion people will move to cities in the next 20 years (ADB, 2008) – an average increase of 44 million people every year. Asian megacities have populations and economies as large as those of some countries of the world. East Asia's urban population produces 92% of its wealth, with Southeast Asia not very far behind at 77% and South Asia at 75%. This means that cities' resilience to future disruptions including disasters and climate change–related threats can determine how fast a country's economy grows. About 250 million people in Asia's urban areas live on less than $1 a day. The urban poor have the least resources and the least capacity to adapt and are the most vulnerable (IPCC, 2001). Alarmingly, Asian cities are likely to contribute more than half the rise in GHGs over the next 20 years while they are also highly vulnerable to the consequences of climate change, including flooding, landslides, heat waves, and shortages of water (ADB, 2008).

It is alarmingly true that, firstly, by the year 2030 every two of three people will live in cities, and secondly, 65% of the world's coastal population is already living in urban areas. It is clear that as urban population will grow, cities will expand both horizontally as well as vertically. The urbanization trends suggest phenomenal change in the way the cities were planned and guided in the past. UN-Habitat's recent report on cities quotes that "by 2050, the urban population of the developing world will be 5.3 billion; Asia alone will host 63 per cent of the world's urban population, or 3.3 billion people, while Africa, with an urban population of 1.2 billion, will host nearly a quarter of the world's urban population" (UN-Habitat, 2008). It is true that "in Africa and Asia, still six out of every ten persons live in rural areas" (UN, 2008). Despite that, in 2007 Asia was home to about half of the urban population in the world, suggests the same document.

UN estimates available at the World Urbanization Prospects 2007 suggests that as soon as by 2025, Asia will be home to 16 mega-urban agglomerations of over 10 million people together with another 25 cities

with 5–10 million people (UNDP, 2007). What is of importance for the Asian cities is to know whether they are prepared to accommodate such a heavy influx of population in the coming years and how cities can brace themselves to enhance resiliency of their residents. Strategies to manage the demographic transitions now will lay the foundation for better tomorrow of the cities to combat climate risks and resulting challenges.

Climate and Disaster Risk in Asia

The number of hydrometeorological disasters have doubled in last few years, and there has been a 50% rise in extreme weather events associated with climate change from the 1950s to the 1990s (IPCC, 2001; UN-Habitat, 2007). Many cities have already started experiencing increased intensity of storms, flooding, water stresses, migration storms, and landslides that climate change is bringing. These and other impacts will also bring the threat of damage to their livelihoods, property, environmental quality, and future prosperity. Urgency to address the increasing threat to cities raises the need for a methodology to measure the existing level of climate disaster resilience of urban communities in order to inform policy options to decision makers for enhancing resilience. In addition, there is a need to find ways to build the resilience of cities, especially targeting urban informal settlements where climate change–induced disaster impacts seem to be the strongest.

> Half of humanity now lives in cities, and within two decades, nearly 60 per cent of the world's people will be urban dwellers. Urban growth is most rapid in the developing world, where cities gain an average of 5 million residents every month. As cities grow in size and population, harmony among the spatial, social and environmental aspects of a city and between their inhabitants becomes of paramount importance. This harmony hinges on two key pillars: equity and sustainability.
>
> – Anna K. Tibaijuka, UN-Habitat (2008)

RESILIENCE BUILDING: RISK REDUCTION AND MORE

A city is exposed to different types of risks, which can be classified into shocks and stresses (Fig. 1). Shock is an unusual event for which an urban community, or a household, does not have the resources to withstand. This ranges in scale and nature, and may be a natural hazard, such as an earthquake, tsunami (for hydrometeorological events), and cyclone/typhoon

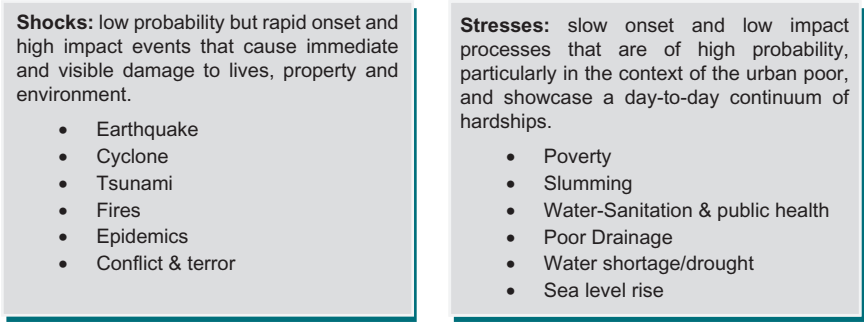

Fig. 1. Shocks and Stresses in Urban Setting.

and floods (for climate-related events), or a man-made one such as a fire, bomb blast, or accident that is not immediately expected, strikes with a suddenness and rapid onset, and has a devastating impact. Stresses erode assets and increase vulnerability in a slow and creeping manner, often not making headlines. They may include unsanitary conditions that lead to poor health and resultant loss of daily wages. At a deeper level, they may include hyperinflation, diminishing purchasing power, and destroying savings. The key elements determining vulnerability in the IPCC definition are exposure, risk, and adaptive capacity. It is important to make a conceptual distinction between risk and vulnerability. Risk is conventionally understood as the likelihood or probability of occurrence of an adverse exogenous event – in this case, climate shocks or stresses. This impact-oriented or risk-oriented approach focuses largely on the physical processes underlying vulnerability to climate change and disasters (Brooks, 2003).

The concept of urban resilience is based on the inherent capacity of cities to bounce back, or recover, after disasters. The concept of resilience is closely related to risk reduction, and it is useful to understand risk reduction tools in order to be able to build resilience in cities.

> Because urban and rural areas are, in fact, interdependent, policies based on the traditional separation of rural and urban economies can inhibit economic growth and damage spatial planning. In reality, a continuum links all settlements and their economies – from isolated farms, through villages, to market towns and regional centres that are surrounded by farmland, on to large urban centers and even megacities, and beyond to their ever-growing suburbs and sprawling peri-urban areas. Coordinating the growth of urban and hinterland economies, and strengthening economic linkages between the city and surrounding areas, are likely to foster improved opportunities for

> both urban and rural development, particularly for the poor. Building on and improving these links, including transport and communications infrastructure, should be a priority.
> – ADB (2008, pp. III–IV)

Asia's share in the world GDP has risen noticeably since 1980 (WDR, 2009), which is largely contributed by the Asian urban agglomerations. Migration from villages and hinterlands to cities in Asia always remained lucrative. Both "push and pull factor" as well as magnetic appeal of cities to offer opportunities at the cost of marginalized living have been at the center of this movement. Despite serious concerns and few attempts by various governments to discourage migration to cities, the success is abysmal. This trend will be aggravated by climate impact–induced migration (some academics refer to people who migrate as "Climate or Environmental Refugees") and is going to raise serious consequences. The world over, estimates suggest that there will be 200 million "climate refugees" by 2050 (IOM, 2008).

A study commissioned by Greenpeace India on climate change discloses that rising sea level could force about 75 million people from low-lying Bangladesh and another 50 million from India's densely populated coastal regions to migrate to interior towns and cities. This may generate severe tensions and instability in the context of already dwindling urban resources (Greenpeace, 2008). IPCC had informed in 2007 that India's glaciers are melting fast and if steps were not taken to check this, there was a likelihood of water shortage in rivers and flooding of coastal regions.

Paths to Urban Resilience

Until now, Asia is primarily rural, and that provides enough reason why nations in this region have paid attention to "rural development," however, at the cost of ignoring "urban planning." To begin with, despite ample traditional and historical knowledge available to design and plan a human settlement, Western models of urban planning dominates the planning practice since about a century. This Western bias has its roots in colonization of major parts of the Asian subcontinent. For the purpose of authority and administration, ruling class maintained distance with local populace and planned the cities in such a way that have created maximum convenience to "rule and command" rather than "cooperate and prosper."

Although cities in Asia are on an average providing 80% of the respective country's economic base, they are still prominently resided by poor people. In most cases, people living in slums and/or under poverty criteria constitute over half of the city population. In contrast to "rural poor" for whom access to

alternative livelihood, transport, health, and education remains a dream, this new class of "urban poor" is the one who has access to all these at the cost of absolute marginalization. This process of formation of slums for temporary living is not so permanent that it is not difficult to find an urban poor family's three generations having spent their lives living in slums with little improvements, which were offered in a piecemeal manner. It needs to be noted that paths to resilience are not yet clearly defined and straightforward. It must be borne in mind that adaptation can also be unsuccessful (Barnett & O'Neil, 2010), and since the understanding on this complex subject is still developing, it can potentially also be detrimental. Fundamentals of physical and social planning must thus ensure safety nets in resilience-building processes.

Need for Harmonious Cities

> Harmony is both a journey and a destination. This (Climate Change) relatively new threat to harmonious urban development is nonetheless directly linked to poorly planned and managed urbanization. Urban sprawl, high dependence on motorized transport and urban lifestyles that generate excessive waste and consume large amounts of energy are some of the major contributors to the global increase in greenhouse gas emissions. … Harmony has now become the theoretical foundation for deepening understanding of the social, economic, political and environmental fabric of cities in order to create a more balanced society. For that purpose, focus is on three key areas: spatial or regional harmony; social harmony; and environmental harmony.
>
> – UN-Habitat (2008, pp. iv, ix)

The process of urbanization is complex and painful. Under the shadow of scintillating city lights of rapidly growing Asian cities lie communities that are not just economically poor but also socially scattered. Origins of risk can be easily traced in the way the cities are growing. People from all parts of the country and sometimes from the neighboring and distant countries migrate to cities that offer better or alternative means of livelihood. This process ensures supply of low-cost manpower for various urban and economic development activities of the city and thus contributes to the overall city development. However, these migrants travel far from their homes, lose regular contact with their social groups, and start living in an environment that is already overcrowded with unknown individuals. The efforts to find common social thread between poor urban residents are strong, and its failure leads to conflict between unrelated communities (UN-Habitat, 2008).

The vicious circle of migrating to cities, losing social safety nets, living in unhealthy and hazard-prone locations, and getting affected by increasing threats to climate change requires specific attention. Betterment of physical

environment alone cannot guarantee enhanced urban resilience. The dividends of community participation in the urban development and risk management are high and will pay well in the times of crises. Participatory approaches in urban development are not uncommon in Asia, but they still have little influence on most urban development policy decisions. The journey to attain resilience of cities calls for strong motivation from policy makers as well as from common residents of the city. Asian cities have a long way to go to ascertain this objectively by stimulating social harmony for urban development.

Environment: The Frontline of Urban Shocks and Stresses

Today, most Asian cities are at the verge of environmental disaster. Astronomical concentration of population and vehicular densities; newer levels of air, water, and noise pollution; and constantly shrinking open spaces – all lead to offer a life that is often most stressful for human habitation in the Asian cities. Almost one out of three urban residents have inadequate access to proper toilets. Over 1 billion people in Asia alone breathe the air that contains outdoor air pollutants exceeding the World Health Organization (WHO) guidelines, leading to the premature death of half a million people annually. Inadequate waste management is propelling the recycling industry in the informal sector in a hazardous way and endangering the health and safety of the people involved. Poor and rich, both are exposed to most of these conditions to varying degrees depending on the affordability to offset some of these environmental burdens. Nonetheless, the overall resilience of the city remains weak if most of the communities suffer stresses beyond human resistance. Climate change is providing yet another significant incentive to strengthen the resilience of the built environment as well as urban societies. It is certainly not too late to postpone this agenda further; otherwise we will be left with "at risk future." Adaptive capacity in fact implies the ability to learn from mistakes and to generate experience of dealing with change (Adger, 2003).

ABOUT THE BOOK

This book has 14 chapters, which are aligned in the process of development of Climate and Disaster Resilience Initiative (CDRI). The first two chapters provide the overview of issues of urban development and resilience. The next four chapters (Chapters 3–6) provide the details of the CDRI implementation form its basics to national, city cluster, and city-level analyses. The next three

chapters (Chapters 7–9) provide insights into the action planning process, followed by two additional chapters (Chapters 10 and 11) on capacity building. The next two chapters (Chapters 12 and 13) focus on roles of different stakeholders in terms of risk communication, and the final chapter (Chapter 14) outlines the future challenges.

As described above, Chapter 1 by Sharma, Surjan, and Shaw outlines the key issues of urbanization and its relation to the changing risk pattern. Urbanization is not the only cause of increasing risk, which is a multifactor impact of complex phenomena. Based on its nature, the risk can be of slow onset (stress) or fast event (shocks). The chapter also focuses on the Asian characters of the cities with specific reference to speedy urbanization. Chapter 2 by Surjan, Sharma, and Shaw analyzes the evolution of the concept of resilience, especially related to the climate-related initiatives in urban context. The chapter argues that the concept of resilience is increasingly getting recognized in international agenda. The link of risk, adaptation, and resilience is discussed with specific examples and cases from different urban contexts. Finally, the chapter also describes the relationship of resilience with emerging urbanization sectors.

Chapter 3 by Joerin and Shaw outlines the climate and disaster resilience mapping using CDRI as a tool. The chapter describes the critical elements of CDRI based on five dimensions of physical, social, economic, institutional, and natural, with 25 parameters and 125 variables. The regional-level CDRI analysis of 15 cities in the Asian countries shows the importance of the results in regional context. Chapter 4 by Joerin, Sharma, Dhar Chakrabarti, and Shaw describes the example of application of CDRI at the country level. By referring to 12 cities in India, the chapter shows the importance of the methodology to categorize the resilience characters of small, medium, and large cities. The cities can also be characterized based on its crucial location, like coastal, mountain, river side, and arid region cities. Based on the city's characterization, different city-based strategies and action plans can be prepared, which link to the CDRI methodology. Chapter 5 by Fernandez, Takeuchi, and Shaw provides an example of CDRI analysis in cluster cities. By providing an example from Metro Manila of the Philippines, 17 city analyses are presented, and a CDRI ranking is calculated. Being in close proximity to each other, the analyses can be used to develop a larger framework of the metropolitan areas. The analysis also helps in understanding the strength and weakness of each city, thereby making the city network cope with different dimensions of climate-related disasters. Chapter 6 by Gulsan Ara, Joerin, Parashar, and Shaw provides examples of CDRI application from three cities: Chennai, Delhi, and Dhaka. The same methodology was used for analyzing

the CDRI mapping in all three cities at the subcity level (like district, or zone level). Putting the city analysis in the context of spatial mapping, the analysis can be useful for city development planning and for understanding the resilience and risk at the subcity level. Specific zone or district-level approach can be made as a result of this analysis.

Chapter 7 by Matsuoka and Shaw provides the base of the action planning process. By describing the Hyogo Framework for Action (HFA) local-level implementation, the chapter identifies 20 specific tasks to be performed at the city level. This, when put across the 25 different CDRI parameters (five each for physical, social, economic, institutional, and natural), gives a workable matrix that links the city services, its resilience priorities, and the HFA local actions. In continuation to the observations of this chapter, the next chapter (Chapter 8) by Fernandez, Takeuchi, and Shaw provides the detailed insights into the action planning process with the city managers. A six-step action planning process is described: resilience mapping, setting priorities, creating the action plan, implementing the action plan, evaluating the results, and updating the action plan. This process highlights that the action planning is not just preparing the plan, but also implementing parts of it (based on the priorities), and updating and revising the plan. This is regarded as the PDCA (Plan-Do-Check-Action) process of action planning. Chapter 9 by Parashar, Sharma, and Shaw discusses the process and examples of community-based adaptation and planning, which is regarded as the implementation of the action plan prepared by the city and/or local governments. The government–community linkage is highlighted by different recent literatures, and through detailed analysis of the community-based approaches; the chapter highlights three aspects: outsider's involvement, social network, and culture as the key driving factors of successful community-based adaptation.

Chapter 10 by Wataya describes a unique process of capacity building of city managers through a blended learning system, which comprises three phases: Phase 1 is the distance learning through moodle, and video conference; Phase 2 is an on-site training; and Phase 3 is the posttraining follow-up. During the first phase, CDRI questionnaires were filled up through training using video conferences; in Phase 2, the results of the analysis were presented and climate action planning was done in a participatory on-site training; and in Phase 3, follow-up was done to finalize the action plan and monitor its implementation. The next chapter (Chapter 11) by Tjandradewi and Berse provides the examples of cities' networks to facilitate city-to-city learning, and provide training in a practical way, which is more relevant to the city's needs. Nine factors are identified for the successful city-to-city collaboration: commitment to link, community participation, common understanding, reciprocity, concrete results,

high-level government support, consistent leadership, cost sharing, and free flow of information.

Chapter 12 by Mulyasari, Shaw, and Takeuchi focuses on risk communication in cities for flood risk reduction. The chapter identifies four types of urban flooding – coastal floods, flash floods, inundation floods, and riverine floods – which are impacted by the changes in the climatic conditions. Citing and analyzing the examples from five countries and regions, the chapter identifies the commonalities and differences in risk communication process for urban flooding. Analyzing the human, natural, and governance causes, the chapter provides a risk communication framework, which is effective for the local stakeholders. Chapter 13 by Izumi and Shaw identifies the roles of the civil society in climate and disaster resilience. Providing examples and case studies on the innovative city-/local government–level interventions, the chapter highlights the linkages of tools, stakeholders, and roles of different institutions. The chapter emphasizes that the civil society plays an important role in the risk communication and implementation of action plan at the local level.

Finally, Chapter 14 by Shaw and Sharma provides some specific directions of future studies and approaches for enhancing the resilience of cities for climate-related disasters. The chapter emphasizes that any city-specific action needs to be incorporated or linked to city services, and there needs to be a clear mechanism of linking the city action plan to community-based implementation. While it is true that the urban resilience is a complex process, there are innovative solutions embedded at the local level, which needs to be highlighted.

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CHAPTER 2

UNDERSTANDING URBAN RESILIENCE

Akhilesh Surjan, Anshu Sharma and Rajib Shaw

INTRODUCTION

Urban resilience is a fairly new but rapidly emerging area of interest. Academia as well as the professional and practitioner communities are increasingly engaged in understanding the characteristics of resilience in complex urban issues. The year 2007–2008 was a historical milestone in human history for two reasons. First, the percentage of urban population to total population in the world touched 50 percent; second, the works of climate scientists were recognized as being so significant that the Intergovernmental Panel on Climate Change (IPCC) received the Nobel Prize for Peace in 2007. Both events are closely associated with and provide special impetus to further research into and understanding of urban resilience, which this chapter discusses further in the following sections.

Origin of the Concept of Resilience

Resilience was first talked about in the 1970s by ecologists who were trying to define ecosystem which gains stability even after disturbances. However, resilience was not discussed much in socioeconomic regimes until the last decade. The recent reemergence of the concept of resilience can be attributed to a lobby of ecologists and economists who advocated the development of a

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holistic understanding of ecological, sociological, and economic systems. They argued that resilience can be built if appropriate policy interventions are made in these three systems synergistically. The Stockholm Resilience Centre (SRC) states that ''resilience is the capacity to deal with change and [to] continue to develop'' (SRC, undated). Social scientists also use the term *resilience* to explain how human capabilities return to normalcy after absorbing stresses or surviving negative changes. The term is fairly new in disaster and climate-change domains because both these fields are still evolving in both professional and academic regimes. The disaster community used the terms *prevention*, *preparedness*, *resistance*, *mitigation*, *response*, and so on to describe various risk-reduction efforts. The climate community deals mostly with two terms: *mitigation* and *adaptation*. However, within the last decade or so, the climate and disaster communities started paying attention to the notions of resilience and examining ways to build, nurture, and increase resilience.

Terminological Convergence and Differences

Resilience and resistance are sometimes erroneously considered to be similar concepts. The idea of resistance is well established in disaster mitigation, and science and technology have contributed significantly to enhancing the resistance of buildings, infrastructure, and so on in response to natural events such as earthquakes, cyclones, and floods. Climate-resistant infrastructure and housing also became popular and have been discussed in the context of hydrometeorological events attributed to climate change. In other words, resistance can be understood as the provision of protective layers to make systems stronger so that natural hazards do not cause significant damage.

Similarly, resilience has also been interchangeably used in the context of or in conjunction with the term *adaptation* in the climate sector. Adaptation experts argue that all the systems are adaptive in nature and are amenable to experienced variability of the climate in general. Adaptation is thus considered to be the process of making appropriate changes to better cope with climate uncertainties or to reduce its negative effects. Understandably, the process of adaptation to climate change may help to achieve resilience, but it cannot be substituted with resilience.

Although the notion of resilience may still be considered as evolving in today's quickly urbanizing world, it is worth noting the definition of resilience offered by some of today's best-known institutions. The Intergovernmental

Panel on Climate Change (IPCC), a leading body of climate scientists, describes resilience as the "ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change" (IPCC, 2007). The United Nations International Strategy for Disaster Reduction (UNISDR), an apex body representing disaster professionals, defines resilience as "[t]he ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR, 2009). The UNISDR definition further explains that "[r]esilience means the ability to 'resile from' or 'spring back from' a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need."

Resilience has been discussed in the academic and research communities for some time. SRC and the Resilience Alliance have significantly contributed to develop the theoretical understanding of resilience. Established in 1999, the Resilience Alliance (RA) is a leading research organization that represents collaboration among scientists and practitioners from diverse disciplines who are exploring the dynamics of social-ecological systems, including resilience. The Alliance defines resilience as

> the ability to absorb disturbances, to be changed and then to reorganize and still have the same identity (retain the same basic structure and ways of functioning). It includes the ability to learn from the disturbance. A resilient system is forgiving of external shocks. As resilience declines the magnitude of a shock from which it cannot recover gets smaller and smaller. Resilience shifts attention from purely growth and efficiency to needed recovery and flexibility. Growth and efficiency alone can often lead ecological systems, businesses and societies into fragile rigidities, exposing them to turbulent transformation. Learning, recovery and flexibility open eyes to novelty and new worlds of opportunity. Resilience is a property of these linked social-ecological systems. (RA, undated)

The Alliance further contemplates that resilience has three defining characteristics: "(1) The amount of change the system can undergo and still retain the same controls on function and structure; (2) the degree to which the system is capable of self-organization; (3) the ability to build and increase the capacity for learning and adaptation."

Several leading Swedish institutions jointly founded the SRC in 2006 to promote "transdisciplinary research for governance of social-ecological

systems with a special emphasis on resilience.'' According to the SRC,

> resilience refers to the capacity of a social-ecological system both to withstand perturbations from, for instance, climate or economic shocks and to rebuild and renew itself afterwards. Loss of resilience can cause loss of valuable ecosystem services, and may even lead to rapid transitions or shifts into qualitatively different situations and configurations, evident in, for instance people, ecosystems, knowledge systems, or whole cultures. The resilience lens provides a new framework for analyzing social-ecological systems in a changing world facing many uncertainties and challenges. It represents an area of explorative research under rapid development with major policy implications for sustainable development. (SRC, 2007)

REFLECTIONS FROM RECENT STUDIES ON URBAN RESILIENCE

Realizing the importance of resilience to an urban ecosystem in which cities are the center of discussion, a few concepts of urban resilience have been proposed by the practitioner and academic communities. For example, researchers from the Institute of Environment and Human Security of the United Nations University (UNU-EHS) introduced the Megacity Resilience Framework, the Rockefeller Foundation helped to establish the Asian Cities Climate Change Resilience Network (ACCCRN), the United States Agency for International Development (USAID) developed the Coastal Community Resilience (CCR) Guide following the Indian Ocean tsunami, and the Resilience Alliance is conducting an important research project titled the Urban Resilience Program. These initiatives suggest that investment in enhancing resilience to climate and disaster risks in an urban setting is gaining ground in different parts of the world. Some of these initiatives are discussed next.

The Megacity Resilience Framework

The Megacity Resilience Framework was introduced by three researchers from UNU-EHS (Carsten Butsch, Benjamin Etzold, and Patrick Sakdapolrak) and published as a policy brief in June 2009 (UNU-EHS, 2009). The narrative of the framework in this section draws heavily from this published work, which describes megacities as a ''new category of human settlements'' growing rapidly in Asia, Africa, and South America. It describes resilience as opposed to *vulnerability* – that is, the inability to cope with risks. This framework further expands the definition:

> A (mega-) city can be regarded resilient if its inhabitants and institutions function effectively. That means that they are able to deal with unexpected disturbances and

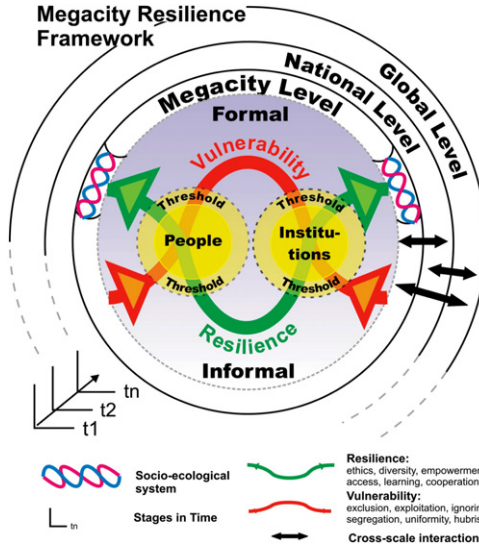

Fig. 1. The Megacity Resilience Framework. *Source:* UNU-EHS, 2009.

adapt to change. Furthermore, ecosystem services and their social and economic use by humans must be balanced. In this sense, the resilience of such a socio-ecological system is closely related to the concept of sustainability (economic, social and ecological).

The Megacity Resilience Framework (see Fig. 1) suggests that

the interaction of people and institutions takes place at the intersection between purely formal and informal spheres. These are, in turn, embedded in the coupled socio-ecological system of the megacity and influenced by processes from the global to the local level. In the framework, the abstract entity, megacity resilience, is illustrated by using the metaphor of a sphere which is either expanding (increasing resilience) or contracting (reducing resilience) in time thereby emphasizes the dynamic notion of resilience and vulnerability.

The ACCCRN Process of Urban Climate Resilience

The Rockefeller Foundation–supported ACCCRN focused on 10 cities in four countries: Thailand, Vietnam, India, and Indonesia. The network's activities are carried out through a joint partnership of leading research, consulting, and nongovernmental organizations. The network recognizes the uncertainty of climate science especially to precise predictions about exact climate impacts and challenges at the city level. The network establishes

"collaboration between outside experts, national partners, local governments, and other organizations" to facilitate cities "to build flexible and dynamic systems and institutions that identify and respond to the challenges climate change poses to urban areas." In November 2009, ACCRN published a report titled *Responding to the Urban Climate Challenge* that describes the approach of the network in the selected cities (ACCCRN, 2009) by seeking answers to the questions presented in Fig. 2. This narrative of the ACCCRN process in this section draws heavily from this publication. The network identified four elements of urban resilience: redundancy, flexibility, capacity to reorganize, and capacity to learn (see Fig. 3).

ACCCRN adopted a common framework known as Shared Learning Dialogue (SLD) to implement the program, which is piloted by Institute for Social and Environmental Transition (ISET), one ACCCRN partner. Fig. 4 shows a schematic diagram of SLD processes, which are considered to be "iterative, transparent group discussions with local actors in communities, government agencies, and specific organizations designed to bring together available information on climate change with local knowledge and perceptions." ACCCRN further recognize that

development of a common understanding of climate change and urban resilience takes time; it requires a process in which insights from multiple sources within communities and

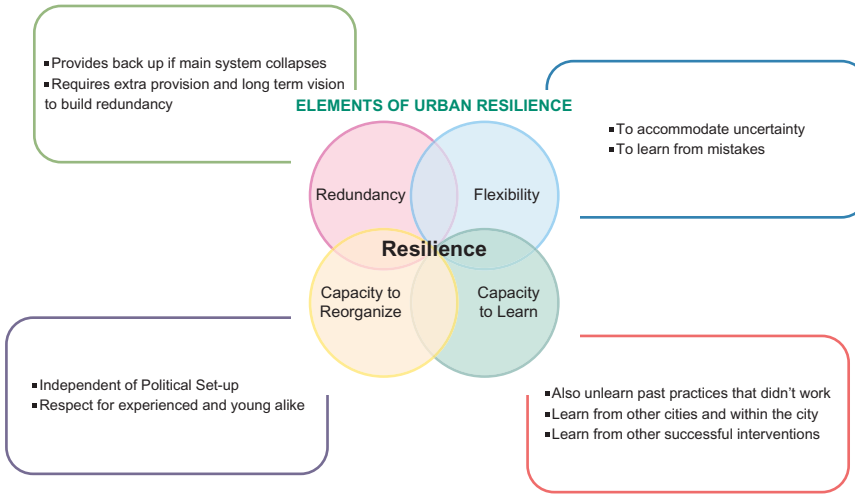

Fig. 2. Elements of Urban Resilience. *Source:* Authors, modified from original adaptation by ACCRN from the Resilience Alliance (undated).

across scales and jurisdictional boundaries can be brought together. The SLD process is designed to ensure that vulnerable populations in each city have the opportunity to build their adaptive capacity and participate in the urban climate resilience process. The ultimate outcome of SLD processes is not just shared understanding but includes actions for responding to climate change risks. The SLD process guides all ACCCRN stakeholders in identifying the constraints and opportunities in adapting to climate change, understanding the complex systems within each of the partner cities, and working with the poor and vulnerable populations to build urban resilience.

Coastal Community Resilience: USAID Guide

In October 2007, USAID published *How Resilient Is Your Coastal Community? A Guide for Evaluating Coastal Community Resilience to Tsunamis and Other Hazards* as part of its contribution to the Indian Ocean Tsunami Warning System (USIOTWSP, 2007). According to USAID, "the guide was developed, building on lessons learned and experience gained in the

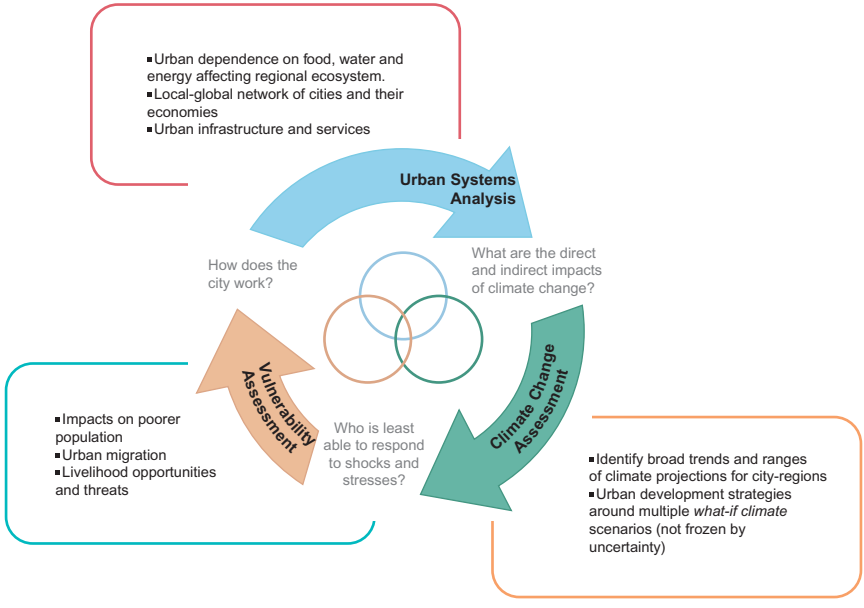

Fig. 3. The Questions ACCCRN is Investigating. *Source:* Authors, modified from ACCCRN, 2009.

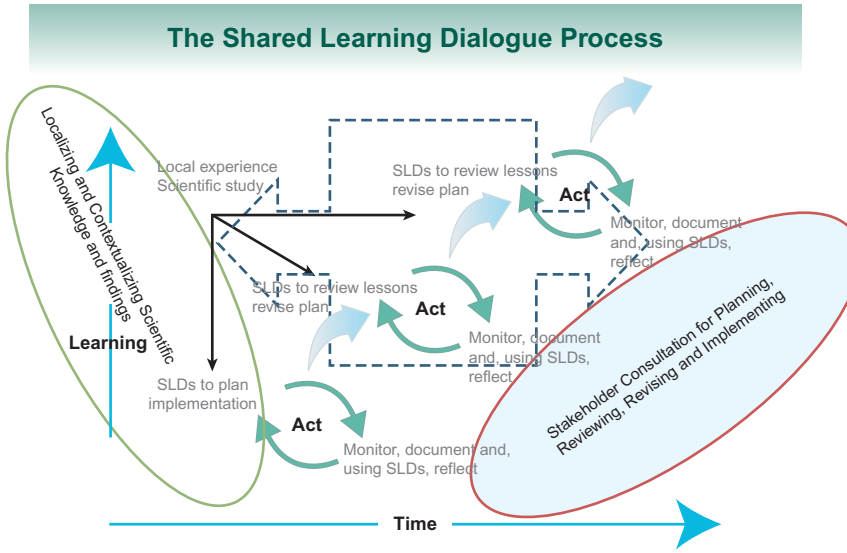

Fig. 4. ACCCRN's Shared Learning Dialogue Process. *Source:* Authors, modified from ACCCRN, 2009.

Indian Ocean region after the 2004 tsunami, to address coastal hazards and reduce risk to vulnerable communities. This guide attempts to broaden the perspective of sector plans so that a more holistic and robust planning framework evolves to truly elevate the potential for community resilience." The description in this section draws heavily from this publication. The guide describes CCR assessment, which is basically a "rapid assessment approach conducted as a collaborative and participatory undertaking by coastal communities, national and local government agencies, NGOs, the private sector, and other key stakeholders to identify strengths, weaknesses, and opportunities to enhance resilience at local and national levels." Convergence of three broad areas – community development, coastal management, and disaster management – forms the framework defined in the CCR guide. The guide considers various coastal hazards, including tsunamis, earthquakes, storms, storm surges, flooding, landslides, spills and chronic pollution, shoreline erosion, sea-level rise, climate variability and change, and coastal resource degradation. It further analyzes factors that contribute to vulnerability in coastal populations. It is clear from this approach that vulnerabilities

Table 1. Resilience Elements and Benchmarks.

	Resilience Element	Benchmarks
1	Governance	Leadership, legal framework, and institutions provide enabling conditions for resilience through community involvement with government.
2	Society and economy	Communities are engaged in diverse and environmentally sustainable livelihoods resistant to hazards.
3	Coastal resource management	Active management of coastal resources sustains environmental services and livelihoods and reduces risks from coastal hazards.
4	Land use and structural design	Effective land use and structural design that complement environmental, economic, and community goals and reduce risks from hazards.
5	Risk knowledge	Leadership and community members are aware of hazards, and risk information is utilized when making decisions.
6	Warning and evacuation	Community is capable of receiving notifications and alerts of coastal hazards, warning at-risk populations, and individuals acting on the alert.
7	Emergency response	Mechanisms and networks are established and maintained to respond quickly to coastal disasters and address emergency needs at the community level.
8	Disaster recovery	Plans are in place prior to hazard events that accelerate disaster recovery, engage communities in the recovery process, and minimize negative environmental, social, and economic impacts.

Source: USIOTWSP (2007).

can be addressed significantly during development planning and sectoral planning in human settlements.

One interesting proposition presented in this guide is that "resilient coastal communities take deliberate action to reduce risk from coastal hazards with the goal of avoiding disaster and accelerating recovery in the event of a disaster." The community is in the center of the discussion, and how people "adapt to changes through experience and applying lessons learned" is crucial for enhancing resilience. This convergence-based guide introduced "eight essential elements of CCR along with benchmarks that characterize the desired conditions for each resilience element." These elements are tabled briefly in Table 1.

The guide also suggests that resilience is not a stable state but a very dynamic concept with a cycle of its own. It argues that there exist "many opportunities to enhance resilience at national and local levels. The generic planning and implementation cycle provides a framework for identifying these opportunities".

Climate-Resilient Cities Approach of the World Bank

In July 2008, the World Bank published *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Climate Change Impacts and Strengthening Disaster Risk Management in East Asian Cities* as "a guide for local governments in the East Asia Region to better understand the concepts and consequences of climate change; how climate change consequences contribute to urban vulnerabilities; and what is being done by city governments in East Asia and around the world to actively engage in learning, capacity building, and capital investment programs for building sustainable, resilient communities" (WB, 2009). This section is entirely drawn from this seminal publication.

The primer explains the impacts of climate change and disaster risk management in the context of East Asian cities and also uses examples of mitigation and adaptation programs associated with sea-level rise, temperature, precipitation, and extreme events. The primer emphasizes that "identifying unique built environment and social characteristics, organizational structure, and skills sets is the first step for a city to deal with the ever-increasing responsibilities of decentralization." The primer offers a tool for assessing vulnerabilities that "leads to determining priorities of actions to move a city away from becoming a 'Hot Spot.'"

The primer emphasizes the linkages between three fronts: disaster risk management, climate change, and development policy. It concludes that "action on any one of these front impacts the city on the other two fronts, and the impact may be either positive or negative. It therefore becomes imperative to ensure that the agenda on any one front does not increase the vulnerability on others. The climate-change agenda needs to be viewed through the prism of the development agenda and should be embedded in the policies for disaster risk management." The primer also advises creating a city information base with all cities' resources consolidated into a single document to form a workbook of climate-change impacts and disaster risk management strategies to guide all development works that will be carried out by government and nongovernment stakeholders. The primer reiterates that potential climate-change impacts are futuristic in nature. Based on model scenarios, climate-change impacts relate directly to disaster risk management, hence connecting different elements to create innovative associations to stimulate discussion and investigation of issues should be given attention for urban resilience.

Urban Resilience Research Initiative of the Resilience Alliance

Urban resilience is a Resilience Alliance initiative for transitioning urban systems toward sustainable futures. The research prospectus for this program was published in February 2007 (RA, 2007). This ongoing research

> aims to provide multi-level understanding of the resilience of urban systems which recognizes the role of metabolic flows in sustaining urban functions, human well-being, and quality of life; governance networks and the ability of society to learn, adapt, and reorganize to meet urban challenges; and the social dynamics of people as citizens, members of communities, users of services, consumers of products, etc., and their relationship with the built environment which defines the physical patterns of urban form and their spatial relations and interconnections.

This research is ''organized around four key themes of inquiry – (1) metabolic flows, (2) social dynamics, (3) governance networks, and (4) built environment – and will select set of comparative urban case studies''. The outcome of this research will be available in the next one to two years.

Summary of Resilience Studies

In this section, five approaches were discussed to understand resilience. These five approaches are discussed by different organizations and have their origin is different schools of thought or practice. Clearly, all these approaches justify the importance of resilience in the world challenged today by climate change. These approaches also reflect on various perspectives and processes aiming at achieving resilience. However, it also appears that resilience is still being discussed, and it is difficult to find convergence of ideas to represent knowledge for application at the city or field level. In these approaches, resilience is seem to be achieved by reducing vulnerability, addressing root causes of localized stresses, providing redundancy in the system, synergizing bottom-up and top-down approaches, engaging stakeholders in developmental interventions, engaging informal and formal systems prevailing in cities, and so on. Identifying risks, assessing vulnerabilities, and integrating methods to reduce human vulnerability in development practices are also prescribed to move toward developing and enhancing resilience. Table 2 summarizes positive attributes and shortcomings of these approaches in the light of urban resilience.

Table 2. Summary and Key Observations of Resilience Studies.

Approach	Key Attributes	Areas Requiring More Clarity
The Megacity Resilience Framework	• Defines resilience as opposed to vulnerability • Resilience is closely liked with concept of sustainability • Institutions and people interact at the intersection of formal and informal spheres	• Social and ecological systems in an urban context needs in-depth description. • Lack of explanation on applicability of this framework to megacities (not small cities). • Institutions and people are very broad categories and for urban systems, these may need further detailing.
The ACCCRN process to urban climate resilience	• Focused study involving international and national players with city level institutions • Accepts and accommodates climate-related uncertainties for urban interventions	• Process of bridging the gap between local knowledge and global knowledge for climate resilience needs further explanation. • Sustainability of externally funded interventions after the project period is not clear.
Coastal community resilience: USAID guide	• Driven from the experience of Indian Ocean tsunami • Focuses on disaster risk reduction • Eight elements are identified for enhancing resilience	• Focuses on coastal community, hence its universal applicability for climate change resilience or urban resilience needs further research. • Eight elements for resilience need to offer flexibility for expanding or shrinking the elements from time to time.
Climate resilient cities approach of the World Bank	• Establishes cyclical links between climate change, disaster risk management, and development policies • Recommends creation of city information base as single document of reference • Links example of mitigation and adaptation with climate-induced risks	• Primer to be used by cities with climate risk needs more concrete examples and targets to be achieved. • Originally prepared for East Asian cities; how it can be used for cities in other regions of the world needs clarification.
Urban resilience research initiative of the Resilience Alliance	• Strong theoretical framework • Aimed at transitioning urban systems toward sustainable future • Very comprehensive framework covering dynamic nature of resilience in cities	• Set of comparative case studies is expected to be made available in near future. Current framework is very conceptual and needs to correlate with field realities.

UNDERSTANDING LINKAGES OF RISK, ADAPTATION AND RESILIENCE

Deciphering Risk: Human and Climate Challenge

Understanding risk with reference to climate change is an emerging discipline, but risk has been part and parcel of human society since before recorded history. It is often pointed out that humans are basically risk takers. It is true in the sense that unless human endeavor challenged and overcame risk, society could not have progressed. On the other hand, the daily lives of humans are filled with risks of various natures and magnitudes. For example, driving an automobile or crossing a busy road are risky affairs, and societies do make such decisions with built-in risks as part of their routines. Experts term such phenomena as *acceptable risks*. Nonetheless, there are certain risks that one would like to avoid, if possible. For example, nobody wants to die in an air crash or car accident, although air travel and car driving are unavoidable realities of most of our lives. Even by selecting an airline with a good safety record or by driving carefully, we may minimize risk but we cannot eliminate it.

Human beings are well aware of weather patterns and their associated risks. For example, seasonal flu and malaria are common in particular times of the year, and medical practitioners have know how to deal with large numbers of patients with such diseases at given times. Natural hazard researchers have been analyzing disaster types and occurrences in a region and can develop frequency cycles of catastrophic and regular events. To certain extent, they can also forecast the possible occurrence of a disaster of a particular magnitude in a region. Climate change, however, poses another new perspective of uncertainty to our understanding of risk. Erratic weather systems, along with sudden downpours and long dry spells, are some of the most common events of present-day fast-paced changes in climate. What we used to observe for centuries and what we get from nature are changing with such an uncertainty that it is difficult to forecast the nature and frequency of hydrometeorological disasters.

Risk reduction practitioners and planners are finding it hard to cope with such uncertainties and are not able to make the sound decisions that are needed to safeguard human-built and natural environments. At the same time, with growing populations and unsustainable use of natural resources, natural environments are deteriorating in unprecedented ways. Groundwater depletion; soil degradation; deforestation; desertification; intrusion of seawater in coastal regions; extreme levels of air, water, and noise pollution; and increasing vector- and water-borne diseases and epidemics are among

the constant human interventions in the natural environment. Unmanaged, ill-planned urbanization poses another major new environmental risk. Haphazard urbanization is mostly taking place in Asia and Africa, and the negative effects of such phenomena on ecological systems and broad spectrum of risks have yet to be completely revealed. In the next 20–30 years, civilization will experience altered understanding of risks arising from complex amalgamation of climate change, chaotic urbanization, and degraded environment. The risk patterns will be affected greatly by migration influxes, poverty, and ever-growing vulnerability of social, economic and natural systems.

Adaptation: An Unavoidable Association with Resilience

The term *adaptation* is becoming more important because, in many cases, it is recognized as being the only option for countries that suffer from the negative impacts of climate change. Adaptation is similar to adjustment and essentially requires the acceptance of some of the given changes in preestablished systems. For example, farmers are used to growing crops under current harvestings cycle and are aware of techniques to preserve seeds, known remedies for pest control, and so on. However, climate change will force them to adjust to more complex weather systems. It may require them to adapt to newer techniques to preserve seeds, shifting cultivation timings, changing the variety of their yields, and preparing for unknown types of pest attacks, among other adaptations. When such adjustments are systematic and planned, the process can be described as *planned adaptation*. However, if such changes are made in an ad hoc manner and without guidance, it becomes *unplanned adaptation*. Furthermore, when such adjustments are made in negative ways that lead to declin in productivity or loss of soil fertility, it can be defined as *maladaptation*.

In the dynamically growing urban context of Asia, adaptation will be rather more complex and painful. It may even require compromises that may initially cause discomfort to many. For example, cities needs to augment new resources of freshwater, invest more in preventing groundwater pollution, employ better techniques to recycle wastewater, enhance the efficiency of water usage in various sectors, force water rationing in places where it is currently wasted, and even reduce the supply of municipal water to once in couple of days or even per week if the need arises. Such measures will not only be required of the water sector but also be needed in sectors such as energy, transport, and waste management. The need of the

hour is to plan for such adjustments in time rather than wait for more certainty about the impacts of climate change in a particular city and region. This makes for an even larger agenda for adaptation to climate change and associated hazards in an urban context.

Resilience: Key to Climate and Disaster Risk Reduction

Resilience, or the capacity to absorb stresses without significantly hampering current development pathways, is a very important element of a climate-disaster risk-reduction strategy. Adaptation calls for adjustments, but resilience requires recognizing a system's inner strengths and boosting them to tackle new challenges. In this context, resilience is a more theoretical concept, but it has wide practical relevance in reducing urban risks. The birth and growth of a city in itself is a challenging exercise, and the core competencies and strengths of all occupants exhibit a certain degree of resilience from the beginning that pave the way for more dynamic interactions of various sectors and actors. Weaving synergies between social norms, diverse cultures, economic growth ambitions, governance in a heterogeneous environment of a city or a megacity is only possible through resilience, which does exist and bind various elements together in a harmonious manner. This binding element may vary from city to city and even within the city, which also helps us understand why some cities or communities are more resilient than others.

Climate change is a potential threat, and the risks of disaster for cities are large. No amount of external intervention, physical safety measures, and economic investment can address the risk-reduction agenda alone. The dynamism of urban societies and their intrinsic strengths now existing in the form of resilience need to be identified, inculcated, nurtured, prospered, strengthened, and augmented to better address the climate-risk agenda in Asia and Africa. *Resilience* is a relatively new term being used by the disaster and climate-change domains, but it is easy to find its mention in both the natural sciences and sociology. In this book, *resilience* is discussed with reference to risk – specifically, risks arising from weather-induced events, including both extreme events (which are also sometimes referred to as *disasters*) and events that are not necessarily disasters but that have significant impacts on existing systems.

Resilience can be understood by various processes that hint at better or lower resilience in a particular system. Higher resilience can be seen in the floods that have affected the city of Surat in Gujarat, one of the wealthiest

states in India. The city of Surat is one of the world's largest centers of diamond cutting and polishing. Recently, the city experienced devastating floods and chaos in managing relief and recovery operations in the first few days after flooding. However, many communities and societies in Surat were very proud and signs proclaiming "No Flood Relief Please" were posted at the entrances of many neighborhoods. The idea was not to refuse relief but to exhibit people's desire for self-help and their tendency to overcome their challenges by own their efforts without external dependence. Monetary support from Gujarati relatives abroad also shows that quick recovery from a major shock also can be rooted in community ties and social bindings that cross geographical boarders. Similarly, efficient local governance structure was proactive in rehabilitation after flooding and was well-supported community resilience. In the recent disaster memory of India, this is one of the few examples of swift recovery and hence a success story of resilience in both communities as well as institutions.

In contrast to Gujarat, Hurricane Katrina was a story of failed resilience. For the most powerful and affluent nation in the world, the United States of America, this hurricane is believed to have been the costliest in monetary terms despite a strong federal government presence and the presence of an authoritative legal entity, the Federal Emergency Management Agency. It is now well accepted that understanding a local community and its engagement is crucial in avoiding losses and building resilience. Many studies pointed out that the neighborhoods in New Orleans as well as many mainstream American communities have been consistently neglected by government. The combination of both policy and socioeconomic factors diluted and, in some cases, eroded trust between policy makers and New Orleans neighborhoods. This led to less evacuation in the initial phase, which led to high numbers of causalities and deaths. Even after reconstruction and rehabilitation programs, many people still refuse to return to New Orleans. This example also illustrates that even though money and resources are important, it is critical to understand and nurture effective trust-based institutions to build resilience.

SYNTHESIZING URBAN RISK THROUGH THE LENS OF URBAN RESILIENCE

Resilience of communities as well as their cities is closely linked to many functions that cities perform under formal or informal systems of governance.

Urban planning, development and management of basic functions, good and poor governance, safety and crime rates, norms and trust – all of these individually and collectively help us understand resilience through different lenses.

Institutional Resilience

Institutions play important roles in present-day cities. Institutes that are responsible for urban and regional planning can make a substantial long-term imprint on the way cities grow and prosper. However, a quick look at the web of authorities present in a typical Asian city shows a complex flowchart of urban management. It is obvious that the higher the number of such specialized agencies in a city, the more difficult it becomes to coordinate. Today, a typical megacity consists of a big city and a number of surrounding settlements with differentiated but common development needs. A regional planning agency, wherever it exists, is expected to meet these needs, but experience shows that it's not very successful. Similarly, the management of urban functions lies with local bodies or *municipal bodies*. These two provide backbone to the planning and managing of cities, which also need to be supplemented by good public transport, climate-resilient housing, all-weather infrastructure, and sustained economic investments. A holistic institutional framework that runs smoothly, is equipped to work efficiently during extreme events, and takes care of future scenarios while performing multifarious functions is a prerequisite for a resilient city.

In an article titled "Adapting to Climate Change in Shanghai and the Yangtze Delta Region (YDR)," Edward Leman discusses institutional challenges to effective adaptation planning in the Shanghai region China's Yangtze Delta Region. The YDR, anchored by Shanghai, is the most important regional economy in the country. YDR consists of two provinces, one provincial-level municipality, 15 prefecture-level cities, 17 county-level cities, and 14 counties. China is a unitary state: relationships between levels of government are rigidly hierarchical, and functional responsibilities are delegated – not devolved – to lower levels of government. This means that hierarchical channels must be followed for all consultations between adjoining jurisdictions. For example,

> "if Jiading District in suburban Shanghai wants to coordinate a plan or program with Kunshan City across the border in Jiangsu Province, its district government must take the request to the Shanghai municipal government, which in turn takes it to the Jiangsu provincial government, which then takes it to the Suzhou prefecture–level municipal

> government, which in turn conveys the request to the government of the Kunshan county–level city. Kunshan's response follows the same tortuous process up and down the hierarchy to Jiading District. Similarly, if a Pinghu county–level city in Zhejiang Province has a request or initiative to propose with Jinshan District across the border in Shanghai, it takes it to the municipal government of the Jiaxing prefecture–level city, which takes it to the Zhejiang provincial government, which takes it to the Shanghai municipal government, which transmits the request or proposal to Jinshan District. Each step requires explicit review by and written approval of the respective government and its affected commissions and agencies."

Leman raises concerns that the preparation and implementation of effective adaptation strategies will be severely constrained by this structure of governance because climate events pay no heed to administrative boundaries and jurisdictions. This example also shows how efficient crossboundary cooperation and interjurisdictional coordination are essential for effective and consistent adaptation.

Participatory Management

Best-practices on participatory management of urban services can be seen in a number of cases around the world, although participatory urban planning is seldom exercised. Over time, the concept of "planning for the people, with the people, and by the people" gained attention but remained a catchy slogan and was never realized. So-called planning from ivory towers or centralized planning still prevails in most coastal Asian cities, partly because of a lack of information on the part of people but more often because of a lack of willingness to involve various stakeholders from various quarters of a city. This dichotomy in city planning results in the birth of another city within the city, which is often referred as an *informal city*. The larger city encompasses both the formal and informal cities with a fair share of both, but it fails to respond to needs of climate and disaster resilience. This is of particular importance in coastal cities, where sea-level rise, coastal flooding, and clashes between informal and formal cities will write a new and unprecedented history.

The Economic Context

The first visible impact of urbanization is the shift from primary to industrial, trade, or service land uses and occupations. The land-use change leads to ad hoc construction activities and congestion. The occupational

change leads to immigration, particularly of males in the working age group. Overall affluence becomes visible in the form of embellished building facades, additional floors, the emergence of motor vehicles, greater spending, and greater amounts of waste. This system helps to create interdependent sectors of the economy both in formal and informal sectors and also generate employment patterns that clearly distinguish haves from have-nots. Certain jobs and service can only be performed with people with specific skills that are not easily available to those who cannot afford to learn them. In the long term, this separation of blue-collar from white-collar jobs rips a city's economic system beyond repair. Very little is known about how to bridge this gap and strengthen a city's resilience.

Ad Hoc Physical Growth

The physical growth happens in the absence of or poor implementation of rules and regulations such as master plans, building bylaws, zoning regulations, subdivision regulations, building codes, and infrastructure standards. Informal housing in urban areas escapes the net of these regulations and grows in an "unengineered" manner, leading to substandard housing stock. In many large cities in the region, more than half the population lives in such conditions. Ad hoc physical growth and the resulting unhealthy housing has many other repercussions. Psychosocial studies already have proven that poor housing restricts residents creative thinking and enhances social unrest. Ad hoc development often is a result of opportunist policies targeted to short-term gains by either political leaders or land-grabbing mafia. However, this provides some form of shelter to those who are otherwise without shelter on any sort. Usually, ad hoc physical growth ignores even minimal basic standards of safety, both physical and societal, and hence hampers disaster and climate resilience of the city.

Solution to ad hoc development lies in phased and planned development. This still remains a long-term process and requires more resources and hence is afforded by a privileged few. Recently, some development has been seen with advancement in precast industrialized construction techniques in China. However, urban development is stitched with many rules and regulations, sometimes so conflicting or otherwise entangled that resolving them consumes most of the energy and time of the interest groups and encourages ad hoc opportunist development while norms of physical safety are ignored. In many cities, new towns and suburbs can be seen as planned settlements in contrast to chaotic downtown sections or fringes. Whether

this development is climate resilient or not remains questionable as climate-sensitive housing and physical development is still a new phenomenon and will take more time to be recognized.

Social Diversity and an Environment of Conflicts

Urban areas become melting pots of socioculturally diverse communities. If the settlement grew as an ecopolis, its very origins are founded in diversity. If it has transformed from a traditional rural settlement, then its social structure diversifies because some of its population emigrates while some immigrants to the big city from distant places find less expensive residences here, leading to the suburban settlement culture. In any case, the wide diversity in terms of ethnic groups, cultures, and other distinctions leads to a fragmented and sometimes fractured society. The various groups live in their own subsettlements with little or no constructive engagement with other groups. Tensions prevail, some over the surface and some under it. Periodically, these erupt as unfortunate incidents of conflict.

Good Governance or Bad Politics

A big challenge in the underlying fabric of urban areas concerns governance and politics, and it has significant implications for the long-term sustainability of any development initiative. Local bodies are often grossly ill equipped in technical, human resource, and financial terms to deal with the complexities of the fast-evolving developmental scene. Politics dominates the municipal environment. As the status of the settlement grows with its growing population, the urban local body also transforms with time and further growth in size. The capabilities and financial resources of the body continue to lag far behind the needs of the settlement in transition and turmoil. Building the capacity of the local body along with community development work becomes a necessity yet remains a major challenge for most initiatives.

Resilience from the Regional Perspective

Although it sounds new, the regional dimension of resilience can be seen from the interwoven functions and services of urban and rural areas in developing countries of Asia. Vegetable, meat, dairy products, and staples

all come from rural hinterlands to cater to meet the needs of a megacity. Even a small impact on agricultural production from weather patterns can significantly affect poor masses living in a city and providing urban services at discounted price. Megacities are like magnets that attract hundreds and thousands of people from surrounding cities to work and enjoy city life. In most Asian cities of major deltas, a significant proportion of population travels to and from the cities to nearby towns and villages. Any major impact on transportation links caused by catastrophic events will immediately result in the loss of major functions on which a city depends. For example, even moderately high rainfall results in an average 30-minute delay in Tokyo's work hours. First, fewer people ride bicycles on a rainy day. Second, already crowded buses and trains become more congested, and more people take cars and further aggravate traffic delay. Water- and wind-related hazards often become more frequent and of higher intensity, affectng the city as well as the surrounding region. Cities with undulating topography or hilly terrain can experience even more erratic impacts from the sudden release of upstream water and the breaching of safety barriers along major water bodies. These examples show that a city or megacity should not only plan for disasters but also take up such exercises jointly at a regional level to better assess risks and determine how to provide mutual help when needed in order to strengthen regional resilience.

RESILIENCE WITHIN SECTORS OF EMERGING URBANIZATION

Life in an urban settlement is full of dichotomies. It has some of the benefits of an urban economy and urban lifestyles while sharing the ills of unorganized growth, poverty, and risk. The quality of life in a small town or peri-urban area is also in transition and often in turmoil. The critical factors affecting the quality of life are population and building densities; city plans, development regulations, zoning regulations, and subdivision regulations; and building bylaws.

Population and Building Densities

A look at time-series data is required to see how a city has grown and to get a better picture of how the population has grown over time and become concentrated in certain pockets. The density of buildings in particular areas could be either the result of a good transport network or because access was

easier for most people. The building density puts more loads on connected services at a particular stretch of the city, creating the potential to overstress the entire network. Similarly, a heat-island effect results in higher temperatures in certain dense pockets of the city; this, in turn, heightens demand for cooling in summer and draws more from the limited energy available for the entire city, thus disturbing an equilibrium.

City Plans, Development Regulations, Zoning Regulations, Subdivision Regulations

Cities are planned to last for long periods of time, if not forever. For ease of planning and administration, a city's spatial development is divided into zones and subdivisions. This exercise is usually done to accommodate competing land uses and functions within a city and within zones in the case of megacities. A smooth flow of functions and hierarchies ensures greater resilience in the city even in times of crises; stressed spatial configurations, on the other hand, lead to weak or negative resilience. The World Bank's *World Development Report 2010* (WDR) notes that "smart urban planning – denser, more spatially compact, and with mixed-use urban design that allows growth near city centers and transit corridors to prevent urban sprawl – can substantially reduce energy demand and CO_2 emissions. It reduces the vehicle kilometers traveled and makes it possible to rely on district and integrated energy systems for heating."

Building Bylaws

Buildings play an important role in the urban landscape. They not only consume enormous energy but also ensure the safety of their occupants. Building bylaws are designed based on geoclimatic conditions, socioeconomic standards, and the building materials and techniques used. If followed properly, building bylaws offer a first line of defense against fire, earthquake, stampede, flood, and cyclone, among other external events. If designed properly, a building can facilitate quick evacuation; a poor planned building can delay it. Unfortunately, the proportion of unengineered buildings remains high in Asian cities. In Delhi alone, an estimated 84 percent of building stock is unengineered. First, most of the construction workforce comes from an informal sector that is untrained. Second, city authorities responsible for implementing building bylaws are exhausted because of the amount of

construction going on at any given time. Third, a lack of awareness on the part of common citizens creates no pressure to see the implementation of building bylaws and hence there is less resilience in the buildings in a city.

Development Authority Functions

Land and infrastructure development in Asian cities is governed by development authorities who are highly controlled by or run by governments. In most cities, the involvement of the private sector is still limited to construction of specialized services or to the maintenance of very limited services. The capacities of government-owed authorities are rather limited and thus does not keep pace with developments happening in coastal cities. Resulting losses in efficiency and functionalities pave the way for development in undeveloped and hazard-prone areas or reserve lands. In the long term, this results in patches of development within a city that defy all norms and safety standards and paralyze already overstressed functions of development authorities.

Municipal Functions

Infrastructure maintenance is the responsibility of municipal bodies. In developing Asia, municipal authorities are highly understaffed and poorly resourced, have very limited technical and managerial capabilities, and thus remain inefficient even in day-to-day civic functions. Poorly maintained infrastructure tends to become dilapidated quickly and cannot withstand the weather-related hazards that loom large in coastal Asia. The task of maintaining infrastructure is also becoming more complex and requires that existing resources be upgraded. Climate change has yet to be recognized in most municipal functions, and planning for climate-related events may be far from becoming a reality.

Incompatible and Hazardous Land Uses

A city consists of bundles of properties of various functions that ideally should complement one another. In practice, however, it is not uncommon to find conflicting land uses in an area, sometimes with disastrous results. One example is the landslide of hills made of solid waste in metro Manila, which resulted in avoidable causalities. Chemicals allowed for earlier use in household and cottage industries in residential sectors are now affecting the local environments. Soil and water samples from residential pockets of

settlements near the Bhopal gas tragedy of 1984 still shows deadly waste being consumed by people indirectly. Industrial disasters are nothing but failed examples of land-use planning that resulted in losses that could have been easily avoided with a little caution.

Transportation

Transportation is both boon and curse to today's life in a city. Unprecedented economic growth has boosted personalized transport in Asian cities. This also happened, however, because governments failed to promote good and efficient public transport. The widespread use of bicycles and other forms of nonpolluting, carbon-friendly transport could not develop because of local weather conditions, lack of pedestrian roads, and the enhanced social status attached to motorized vehicles. The astronomical increase of two wheelers followed by cars is not only increasing dependency on traditional fuel supplies but also increasing air pollution to unhealthy and perhaps dangerous levels. Although personalized transport is also seen as an indicator of prosperity among social peers and offers multiple efficiencies and thus business opportunities, it also leads to increasing numbers of accidents and deaths. Traffic delays and traffic jams on metropolitan roads is a daily occurrence. Because of poor road and bridge planning, weather events bring more water saturation and flash floods into already congested cities, making it difficult for both public and private transport to navigate the roads. Improving transportation conditions is one of the important dimensions of improving the resilience of cities. For example, in the past five years, on average, more than 10 people die every day in local train accidents in Mumbai. Although this reflects the severe neglect of the railway system, it also reveals the attitudes of citizens toward everyday risks in the larger framework.

Economy

The workforce of a city can be broadly categorized as blue-collar and white-collar workers, although there are many shades of work in the economy of a megacity. Working conditions for these categories varies significantly and affects the health of workers as well. The other face of the city is clearly visible with the fact that the rich need the poor to provide invisible services that support their visible affluence. There is no dearth of contrasting images in cities. However, if understood correctly and taken seriously, climate

change can create green jobs and help to generate a more harmonious workforce that bridges the gap between the upper and lower sections of an economy.

Financing urban management is another difficult dimension. Money is usually available to develop new infrastructure or housing and facility, but little or no provision is made for its maintenance. The root cause also lies in the welfare state model, which prohibits users from paying for services. As a result, most basic services of the city are highly dependent on government grants and are hardly self-sustainable. The culture of insurance in cities is also questionable. Insurance helps to transfer risk or at least minimize the prolonged effects of risk after a disaster. However, insurance for fire, earthquake, floods, cyclones, and such is rare in Asian cities. Insurance-sector penetration in urban sectors can offer a smart way to build resilience against climate-induced risks.

Shelter

Housing not only fulfills basic need but also provides the first line of defense against weather. Housing is also recognized as an important element in creating low-carbon cities and societies. Affordable yet safer housing is a dream for more than half of the city dwellers who are forced to live in shelters that are actually unfit for human accommodation. Shelter design and construction is very deeply attached to human endeavor, and low-cast, self-help, energy-efficient housing development has a potential to create resilient cities while preparing them against extreme events. Housing shortages are one of the most severe crises faced by modern-day Asian cities. The shortage is so critical that it forces families to live in overcrowded conditions or in slums, both of which are considered unfit for habitation. Women and child have to live in the most indecent conditions because poor-quality housing often lacks toilets, water, and privacy. The resulting unhygienic conditions make these shelters breeding grounds of weather-related diseases such as malaria and dengue.

Water, Sanitation, and Health

Water and sanitation systems become inadequate when facing increasing populations and obsolete in technology for servicing residents. In addition, traditional indigenous knowledge is dying, thereby further crippling old systems

such as wells, which are no longer cleaned but remain the fallback water supply. Poor-quality sanitation in urban areas is often cited by development practitioners as the story of urban slums. The invisible disposal of affluent wastes also transfers the risk elsewhere within the city. The other side of the city can be witnessed at its best at the solid-waste dumping stations. Water, especially potable water, is becoming a precious resource in Asian cities. Cases of water stress are so severe in many cities, especially in summer, that a new term – *urban droughts* – has been coined for them. Many cities receive municipal water supplies once every two or three days. Even in that case, the quality of water as well as the duration of the water supply cannot be guaranteed. A big concern in the context of climate change is not enough water versus too much water. Sometimes it seems abundant water in the rainy season can be managed to cover water shortages in summer when is not available. However, the issue is beyond this simple understanding of demand and supply and the havoc created in the everyday lives of urban dwellers in Asia.

Public health suffers greatly from rapid urban transitions. Affluence brings with it a culture of greater consumption and greater waste generation. In the absence of adequate waste-management systems, household waste, wastewater, industrial effluent, toxic wastes, nonbiodegradable waste, and air and noise pollution all linger in the environment with ever-increasing concentrations. The already inadequate medical services cannot cope, and public health is hit hard.

RESILIENCY PLANNING

The discussion so far in this chapter clearly illustrates that resiliency in urban areas is a very complex topic but will play a defining role in any climate-affected future. The question arises here is whether it is possible to plan for resilience. If yes, what are the entry points to initiate these planning interventions? Other chapters in the book will discuss various field-based cases in detail. Three indicative sectors of interventions are briefly described next: spatial planning, institutional synergies, and community interface.

Spatial Planning

As discussed earlier, spatial planning or city planning procedures in current conditions are gradually becoming redundant. Cities are being planned based on the information available and projections for given conditions,

which are static in nature and do not account for the dynamic nature of changing urban patterns and climate-related risks. Sudden extreme events have the potential to cause behemoth disruptions to urban environments, and city planning needs to pay careful attention to these issues to ensure a resilient future.

Institutional Synergies

A resilient city is a utopian thought at the moment but one that must be prioritized by key institutions at the city level to become real. Currently, there are very limited examples of public- and private-sector institutions working hand in hand to address urban issues. Notably, these partnerships are more prominent during crises or catastrophic events. For example, if a city experiences a sudden downpour or a typhoon, it immediately sparks the corporate sector to show its solidarity and social responsibility through various activities that help government efforts. However, this is not the case for growing stresses building within a city. At the same time, unfortunately, public-sector institutions such as higher-education institutes, research institutions, national and provincial government departments, and local government functionaries do not work in an informed manner. This often leads to mismanaged functions or redundant or contradicting actions, albeit unintentional. For example, maintenance and repair of telecommunications infrastructure during the monsoon season may require digging roads or footpaths or temporarily closing certain roads that may be crucial for safe evacuation or smooth transport.

Community Interface

Growing populations in Asian cities is often misunderstood to be part of the problem. Population growth projections and migration scenarios are usually highlighted to note the fact that the carrying capacity of a city is sure to collapse in such scenarios. However, cities also are one of the most efficient forms of human settlement, offering immense possibilities of energy efficiency, transport efficiency, and land-use maximization, among others. Urban-redensification and urban-renewal schemes in many Japanese cities are consider to be opportunities for more community dialogue, consultation, and goal setting. The Tokyo metropolitan government recently launched a carbon-trading scheme. Before the launch, the government

organized intensive consultations with citizens, large building owners, the private sector, offices, schools, and so on and incorporated the most valuable suggestions. As a result, the implementation of this carbon-trading scheme is achieving targets on time and with remarkable support from all stakeholders in the city.

CONCLUSION: RESILIENCE IS A LOW-HANGING FRUIT

This discussion in this chapter reviewed various concepts, methods, perspectives, and challenges related to urban resilience. Although more ground-level research is needed in this sector and more international attention is needed for this approach, resilience can still be regarded as low-hanging fruit. Cities are major emitters of greenhouse gases, and even the greenhouse gases emissions happening beyond city boundaries may be servicing the need of the urban dweller. Hence, this is the time to find out how the structure of urban community is changing gradually. The urban community is better informed and better equipped compared to its rural counterparts. This strength must be correctly captured to quickly upscale resilient visions of the cities. The high level of awareness among urban masses can be further influenced as high level of action. Urban population by the virtue of living in cities and struggling with various routine urban problems can be an excellent source to channelize urban solutions as well. While the governments and the private sector will play their respective roles to secure the city for future shocks, off the radar screen risks can prove entry points to galvanize urban communities to scale up resilience which is clearly a low-hanging fruit in the gamut of climate politics, uncertainties and mistrust prevailing in international negotiations on climate change. The humanity in the developing world has arrived at the take-off stage to combat climate challenge and resilience is the ideal fuel to spur the momentum.

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CHAPTER 3

MAPPING CLIMATE AND DISASTER RESILIENCE IN CITIES

Jonas Joerin and Rajib Shaw

INTRODUCTION

In this chapter the objective is to link the causes (risks) with the need of disaster resilient entities (urban areas) in an era in which the climate is changing and natural hazards are likely to occur more frequently and more severely (Intergovernmental Panel on Climate Change (IPCC), 2007). The previous chapters defined what a resilient city is and how it can be understood, but another question may arise subsequently: how to measure a disaster resilient city? This is what this chapter is about: to develop a tool that is capable of adequately addressing the vulnerable parts of a city's functional system, and additionally, its responsive capacity to cope with a potential disaster. This tool – named Climate Disaster Resilience Index, which is only the process of measurement, or Climate Disaster Resilience Initiative (CDRI), which encompasses all aspects of this approach – shall demonstrate how different functionalities of a city can be assessed in a comprehensive single attempt. Accordingly, the CDRI is more than just a tool to measure the condition of a city at a certain point of time; it also has the wider ambition to lead communities and local governments onto a path of sustainable development that ought to increase the overall resilience level of their city to climate-related disasters. As a result, the CDRI tool shall serve as an urban planning tool depicting the sectors within an urban context that are more or less resilient.

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Since already some approaches exist to measure cities' vulnerability to disasters (The World Bank, 2009; WWF, 2009), the CDRI goes beyond these vulnerability assessments and includes aspects of urban resilience, such as the responsive capacity of communities and institutions in case a climate-related disaster occurs. Accordingly, the differences between various assessments to address the risks in urban areas shall be discussed in the next parts of this chapter; furthermore, disclosing the challenges between the understanding of vulnerability and resilience is crucial in order to understand the ambitious goal of making cities resilient to climate-related disasters.

The structure of this chapter is as follows: first, a literature review explains the origin of the CDRI; second, the CDRI and its characteristics are highlighted; third, the different partners/stakeholders who are likely involved in a CDRI are mentioned; fourth, the potential of the CDRI to make cities safer from climate-related disasters is emphasized; and finally, key points are concluded.

MEASURING RESILIENT URBAN AREAS

Context of Urban Resilience

Although Surjan, Sharma, and Shaw (in press) emphasize the origin of the term "resilience," this term shall be reiterated here briefly in order to smoothen the understanding and challenges of measuring resilience in urban areas, and also to facilitate the origin of the CDRI. One of the early origins of the term is in the ecological field of science, where the ability of populations to absorb change and maintain relationships is considered as a resilient system (Holling, 1973); this term was gradually expanded to explain interactions in socio-ecological systems (Carpenter, Walker, Anderies, & Abel, 2001). In this context, social systems or the ability of communities to deal with disturbance is explained using the term resilience (Adger, 2000; Twigg, 2007). While communities are key actors in shaping the overall resilience of a system like a city (Godschalk, 2003; Klein, Nicholls, & Thomalla, 2003; UNISDR, 2009b; Vale & Campanella, 2005), the concept of resilience shall be related with the context of urban areas, where the social fabric is embedded into a system shaped by the physical, institutional, and natural characteristics inherent in cities (Pelling, 2003).

Following Carpenter et al.'s (2001, 766pp.) interpretation where a socioecological system's resilience is defined, the use of the term resilience

connected to disasters shall be drawn. The resilience there is defined as follows:

- the amount of change the system can undergo and still remain within the same domain of attraction;
- the degree to which the system is capable of self-organization;
- and the degree to which the system can build the capacity to learn and adapt.

Accordingly, Twigg (2007) related the term resilience to disasters at the community level, where he described a community's ability to absorb, maintain, and bounce back "after" an incident or disturbance, whereby the incident or disturbance can be related to the understanding of a disaster.

Adopting the UNISDR (2009a, 24pp.) terminology where resilience to disaster is explained as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions," the terms system and community are mentioned as attributes that are targeted to be resilient following a disturbance or disaster. This definition allows certain openness big enough to interpret disaster resilience in urban areas, whereby a city or an urban area may simply be described as a system consisting of different actors, physical and natural contexts.

This brief reiteration of the term showed the linkage between the historical use of resilience and how it is gradually transformed into the context where it can be applied to disasters. This will be discussed again later in this chapter. Although the term resilience to disaster is to some extent defined, it is not yet clear how this resilience is measured in urban areas and how to develop an adequate tool for this process. Therefore, one key aspect needs to be considered: who or what is expected to be resilient to a disaster? To conclude, the aim of this chapter is to contribute to the urgent need (Cutter et al., 2008; Klein et al., 2003) of developing tools capable of addressing the relevant sectors in an assessment in order to make cities more resilient to weather- or climate-related hazards, like cyclones, floods, or droughts. This aim is also addressed by other scholars/organizations such as The World Bank (2009) and the WWF (2009) in their recently published approaches, which are further described by Surjan et al. (in press).

Transforming the Hyogo Framework for Action from National to Local Level

A major driver to address the vulnerability and resilience of cities is enabled through the international recognition that actions to reduce the risks of

countries to potential disasters need to be addressed more thoroughly, as the policy document Hyogo Framework for Action (HFA) was adopted by 168 countries in 2005 (UNISDR, 2005) and is now signed by almost all UN nations. This framework, explained in more detail by Matsuoka and Shaw (in press), shall help governments to develop frameworks that address disaster risks and lead the countries onto a path where they become more resilient to disasters; accordingly, five priorities for action define the overall framework (UNISDR, 2007), which shall be addressed in the CDRI questionnaire, explained later. However, it was recently recognized that actions shall not be taken purely at the national level to address disaster risks, but much more where they actually happen, like in cities (UNISDR, 2009a, 2010). Cities, or the local level, are seen as a suitable level to efficiently initiate action, especially in developing countries where urbanization is a major risk factor, as explained in Chapters 1 and 2. Thus, action and the focus on cities with their growing communities (UN, 2010) and higher level or intense risk character (UNISDR, 2009a) are internationally recognized and also confirmed by various scholars (Godschalk, 2003; Klein et al., 2003; Pelling, 2003; Satterthwaite, Huq, Pelling, Reid, & Romero-Lankao, 2007; Vale & Campanella, 2005) to be made more resilient in order to reduce losses of human lives and infrastructures in case a disaster occurs.

CONCEPT AND METHODOLOGY OF CLIMATE DISASTER RESILIENCE INDEX (CDRI)

The Disaster Resilient City Applied in the CDRI

The literature review draws not only a connection describing resilience in the context of disasters but also its application in urban areas. To apply the term disaster resilience into a tool, named CDRI, the objective of this assessment needs to be clarified, which means what is a resilient city and how it can be understood?

Godschalk (2003, 137pp.) defines it as "a sustainable network of physical systems and human communities" and Vale and Campanella (2005, 353pp.)define it as "a constructed phenomenon, not just in the literal sense that cities get reconstructed brick by brick, but in a broader sense." Finally, a resilient city "is able to sustain itself through its systems by dealing with issues and events that threaten, damage, or try to destroy it" (The World Bank, 2009, 32pp.). All these definitions incorporate the notion that either some disturbance

or some threat may challenge the well-being of a city. These definitions also underpin the need to address various aspects of resilience that are challenged before the occurrence of a disaster, like the provision of urban services in the form of electricity, water, solid waste, or the condition of the road network, as they are likely to influence the potential of loss and harm due to a disaster, and therefore, have implications on the resilience of different stakeholders (communities and institutions) and aspects of the city (physical, economic, and natural) and how they respond in the aftermath of a disaster. For instance, if the quality of housing is poor and building codes are not well implemented, the resilience is lower and subsequently diminishes the responsive character to absorb a potential disaster. Or if a community has large unemployment rates, its capacity to bounce back is limited. Similarly, if the ecosystem is in bad shape and has low quality levels like contaminated water bodies, a potential event of flooding may affect the health of communities and the wider natural environment, as further parts of the city get contaminated, and therefore, the ability to respond is likely to be hampered and might be reduced.

Development of the CDRI

At this point, the CDRI comes into play to provide a comprehensive baseline assessment that addresses these linkages between various actors, aspects of the physical, social, economic, institutional, and natural components of a city or an urban area. Accordingly, the CDRI is a planning tool that has the objective to disclose the sectors that are least resilient or not capable of responding adequately in the event of a climate-related disaster. Table 1 shows the 5 dimensions and 25 parameters/indicators shaping the overall content of the latest CDRI questionnaire, adopted for assessments at microlevel in the cities of Chennai, Delhi, and Dhaka (see Gulsan, Joerin, Parashar, & Shaw, in press).

Accordingly, the methodology of the CDRI was modified several times from its establishment in 2008 until 2010. Originating from a primary CDRI study, undertaken in 15 cities all located in the Asian region, a different form of questionnaire was not consisting of five parameters for each dimension; however, the use and importance of the five dimensions (physical, social, economic, institutional, and natural) were already recognized in the first edition of the CDRI. In the studies done by Joerin and Shaw (in press), Fernandez, Takeuchi, and Shaw (in press), and Gulsan et al. (in press), a 5×5 matrix was adopted to harmonize the CDRI and to facilitate each dimension with the same weight. The reasons for this harmonization are as follows: first, each dimension is important (see literature review and previous chapters), and

Table 1. Content of CDRI Questionnaire, 5×5 Matrix.

Physical	Social	Economic	Institutional	Natural
Electricity	Population	Income	Mainstreaming of DRR and CCA	Intensity/severity of natural hazards
Water	Health	Employment	Effectiveness of zone's crisis management framework	Frequency of natural hazards
Sanitation and solid waste disposal	Education and awareness	Household assets	Knowledge dissemination and management	Ecosystem services
Accessibility of roads	Social capital	Finance and savings	Institutional collaboration with other organizations and stakeholders	Land use in natural terms
Housing and land use	Community preparedness during a disaster	Budget and subsidy	Good governance	Environmental policies

therefore, no dimension shall be favored in the final outcome of the CDRI; second, the calculation of the CDRI scores becomes more transparent and structured since each parameter is further defined by another set of five variables, resulting in a total of 125 variables for the entire CDRI.

The various modifications of the CDRI over time and at different urban levels (cluster level, city level, or microlevel) led to the current version (Table 2), where different aspects of resilience of a parameter define the CDRI.

CDRI Questionnaire, Data Collection Process, and Analysis

As the previous section mentioned, the CDRI questionnaire consists of 125 variables, equally split into five dimensions and again divided into five parameters; moreover, each variable (x_1, x_2, …, x_5) provides five choices of answer between not available/very poor (1) to best (5). In addition, all variables within a parameter, consisting of five variables, have to be ranked (w_1, w_2, …, w_5) between each other in the range of not important (1) to very important (5) in order to give a particular variable a higher or lower weightage in the calculation of the CDRI scores.

Table 2. Dimensions, Parameters, and Variables of CDRI Questionnaire.

Physical	*Electricity* (access, availability, supply capacity, alternative capacity)
	Water (access, availability, supply capacity, alternative capacity)
	Sanitation and solid waste disposal (access to sanitation, collection of waste: treated, recycled, collection of solid waste after a disaster)
	Accessibility of roads (percentage of land transportation network, paved roads, accessibility during flooding, status of interruption after intense rainfall, roadside covered drain)
	Housing and land use (building code, buildings with nonpermanent structure, buildings above water logging, ownership, population living in proximity to polluted industries)
Social	*Population* (population growth, population under 14 and above 64, population informal settlers, population density at day and night)
	Health (population suffer from waterborne/vector-borne diseases, population suffer from waterborne diseases after a disaster, access to primary health facilities, capacity of health facilities during a disaster)
	Education and awareness (literacy rate, population's awareness about disasters, availability of public awareness programs/disaster drills, access to Internet, functionality of schools after disaster)
	Social Capital (population participating in community activities/clubs, acceptance level of community leader [in ward], ability of communities to build consensus and to participate in city's decision-making process (level of democracy), level of ethnic segregation
	Community preparedness during a disaster (preparedness [logistics, materials, and management], provision of shelter for affected people, support from NGOs/CBOs, population evacuating voluntarily, population participating in relief works)
Economic	*Income* (population below poverty line, number of income sources per household, income derived in informal sector, percentage of households have reduced income due to a disaster)
	Employment (formal sector: percentage of labor unemployed, of youth unemployed, of women employed, of employees who come from outside the city, of child labor in city)
	Household assets (households have television, mobile phone, motorized vehicle, nonmotorized vehicle, basic furniture)
	Finance and savings (availability of credit facility to prevent disaster, accessibility to credits, accessibility to credits for urban poor, saving practice of households, household's properties insured)
	Budget and subsidy (funding of DRM, budget for DRR sufficient, availability of subsidies/incentives for residents to rebuild houses, alternative livelihood, health care after a disaster)
Institutional	*Mainstreaming of DRR and CCA* (mainstreaming of CCA and DRR in cities development plans, ability [manpower] and capacity [technical] to produce development plans, extent of community participation in development plan preparation process, implementation of disaster management plan)

Table 2. (*Continued*)

	Effectiveness of cities crisis management framework (existence and effectiveness of an emergency team during a disaster: leadership, availability of evacuation centers, efficiency of trained emergency workers during a disaster, existence of alternative decision-making personnel)
	Knowledge dissemination and management (effectiveness to learn from previous disasters, availability of disaster training programs for emergency workers, existence of disaster awareness programs for communities, capacity (books, leaflets, etc.) to disseminate disaster awareness programs (disaster education), extent of community satisfaction from disaster awareness programs)
	Institutional collaboration with other organizations and stakeholders, during a disaster (cities dependency on external institutions/support, collaboration and interconnectedness with neighboring cities, cities cooperation (support) with central municipal department for emergency management, cooperation cities ward officials for emergency management, cities institutional collaboration with NGOs and private organizations)
	Good governance (effectiveness of early warning systems, existence of disaster drills, promptness of city body to disseminate emergency information during a disaster to communities and transparency of city body to disseminate accurate emergency, capability of city body to lead recovery process)
Natural	*Intensity/severity of natural hazards* (floods, cyclones, heat waves, droughts [water scarcity], tornados)
	Frequency of natural hazards (floods, cyclones, heat waves, droughts [water scarcity], tornados)
	Ecosystem services (quality of city's biodiversity, soils, air, water bodies, urban salinity)
	Land use in natural terms (area vulnerable to climate-related hazards, urban morphology, settlements on hazardous ground, amount of Urban Green Space [UGS], loss of UGS)
	Environmental policies (use of city-level hazard maps in development activities, extent of environmental conservation regulations reflected in development plans, extent of implementation of environmental conservation policies, implementation of efficient waste management system [RRR], implementation of mitigation policies to reduce air pollution)

Accordingly, the constant use of five choices, ranks, or weights allows the adoption of a formula named weighted mean (see Fig. 1) to calculate results for each variable, parameter, and dimension of the CDRI in a standardized and harmonious approach.

The key organization in filling up this questionnaire depends on the context. However, generally different departments within a local government, mainly the planning department, are required to provide answers either through secondary data for quantitative questions or through a well-thought perception (best answer) to provide responses for qualitative

$$\frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} = \frac{w_1 x_1 + w_2 x_2 + w_3 x_3 + w_4 x_4 + w_5 x_5}{w_1 + w_2 + w_3 + w_4 + w_5}$$

Fig. 1. Formula – Weighted Mean for Calculating a Score of a Parameter.

questions and also for those quantitative questions for which no data is available. Since the context for data collection varies from study to study, the key organizations are also changing.

Once the data is collected, through these organizations, the data is inserted into spreadsheets, for example, Microsoft Excel and the above-mentioned (Fig. 1) weighted mean is calculated in a simple analysis to deliver the results. Now, what types of further analyses are sought out of these 125 variables and numerous weightings? Various examples are given in the following chapters where the results of CDRI studies are presented; nevertheless, spider diagrams are largely used to show the varying conditions of different dimensions and parameters for a selected type of urban area. In addition to this mapping out of results, correlations between dimensions, parameters, and variables have the potential to develop connections between different aspects; for instance, in the study by Gulsan et al. (in press), high correlations are shown between parameters of income and household assets, emphasizing that there is a clear connection between availability of money (income) and transformation into wealth (household assets).

Accordingly, context-based analyses allow drawing the right solutions for the effective development of sound solutions/practices in those sectors where the condition is lowest. This is also discussed later in this chapter.

INTERPRETATION OF CDRI SCORES

As the range of scores of the CDRI results is between 1 (low) and 5 (high), the numerical value itself is not the most important aspect in understanding the overall CDRI or dimension-wise results. What is more important in interpreting the scores is to evaluate which dimensions, parameters, or variables are particularly low or high in order to take action in those sectors where needed most. The reasons for this more qualitative interpretation of the results are as follows: first, a standardization of CDRI scores is not yet available and would be too premature at this stage due to the limited number of case studies; second, the context of each city or part of a city

varies with regard to topographical and geographical aspects; third, the key aims of the CDRI are to reduce the risks and to make urban area more prepared and capable of withstanding climate-related disasters, which means that qualitative interpretation of the weaker and stronger sectors of a city is sufficient to spur this process in terms of aspects of planning.

CDRI AT REGIONAL LEVEL

As the first CDRI study was conducted in the Asian region among 15 cities (Fig. 2), the structure of the first CDRI questionnaire was to some extent different from the following studies, as mentioned before. Although, the five dimensions already existed, the different parameters defining it were not structured in the 5×5 format.

As a result, the dimensions consisted of unequal numbers of parameters and variables. However, the weighted mean formula was already used at that time. The overall CDRI results are shown in Fig. 3 and range between scores of 4 and 7. The collection or distribution of questionnaires also targeted city governments to provide answers about the condition of their city. In this context, a workshop was held in Da Nang in 2009 to train city managers. This event also served to distribute a self-evaluation matrix among the members of the city government of Da Nang to ask them about how different parameters (roads, solid waste disposal, etc.) can be improved and within what kind of time horizon certain actions would be implemented, like short term (2–3 years), medium term (up to 5 years), and long term (up to 10 years).

CDRI AT CITY LEVEL AND MICROLEVEL

As it was pointed out before, the development of the CDRI questionnaire experienced several modifications and was tailored to the specific context of a particular study. This means that the CDRI questionnaire used at city (Joerin et al., in press) or city-cluster level (Fernandez et al., in press) is not the same as the one applied at microlevel (Gulsan et al., in press). Besides tailoring certain questions to the local characteristics of a particular study, the CDRI questionnaire also assumes the changing administrative context (institutional dimension) whereby the focus at microlevel concentrates on local-level decision making rather than on the powers available at the city level. For example, at microlevel the involvement of ward officials becomes

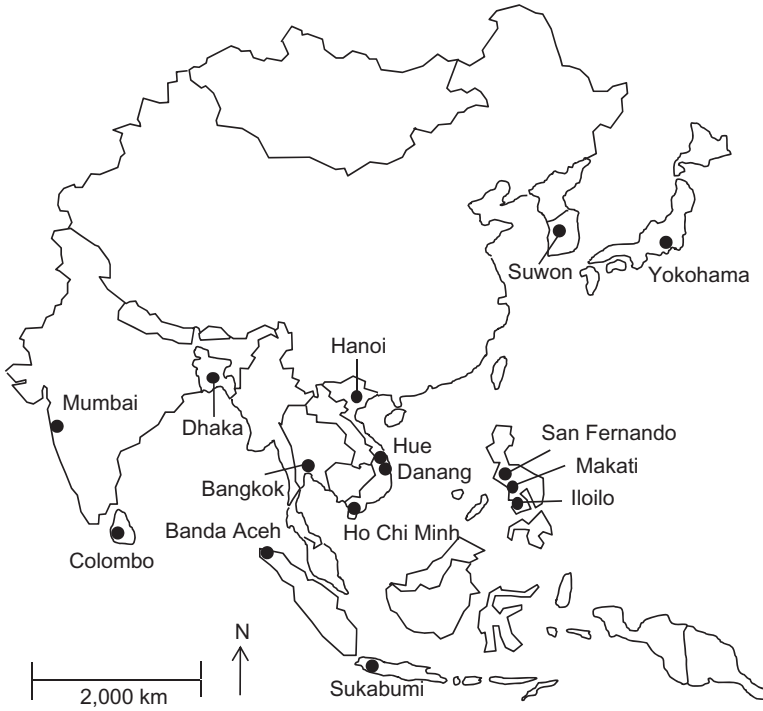

Fig. 2. The 15 Cities of the First CDRI Study in the Asian Region.

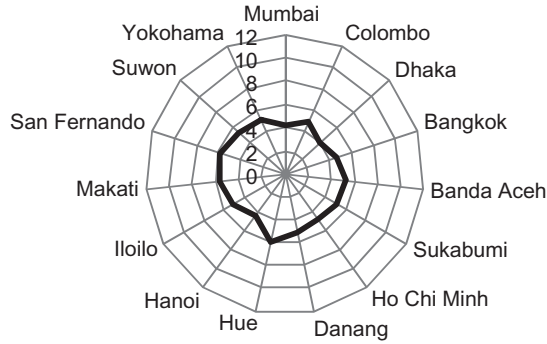

Fig. 3. CDRI Overall Results from the 15 Cities.

more important than at city level in analyzing the institutional condition of a specific area within a city. Another example, in the institutional dimension, namely the development of housing or transport plans/policies, is a matter dealt at city level rather than at the microlevel; therefore, they are replaced by the capability of the microlevel administrative body to produce development plans that address disaster risk reduction (see Table 2). Furthermore, the ''newest'' CDRI version at microlevel addresses more specifically the priorities set out in the HFA.

In other words, the CDRI questionnaires at microlevel are more tailored to the specific administrative conditions where the policy framework is already given; accordingly, the city-level questionnaires assess the conditions from the higher administrative level of power. This variation is needed to address the different local contexts in varying types of urban areas.

CHALLENGES AND POTENTIALS OF THE CDRI

Certain limitations of the CDRI include the following: although the CDRI covers a large variety of aspects that represent either vulnerability, or resilience, or both of a parameter, the large number of variables (125) is posing a great challenge for local authorities to answer the questionnaire adequately. The problem lies in the lack of data for various variables, which as a result demands the authorities' best choice to give valuable answers for those variables for which secondary data do not exist. In addition, since local authorities are the target group for filling up the CDRI questionnaire, the CDRI depends on data and views coming from local authorities that may not sufficiently reflect communities' view on the urban areas' condition.

Another limitation of the CDRI approach is that only hydrometeorological hazards or climate-related hazards, like storms, floods, rainfall-induced landslides, or droughts, leading to disasters are reflected; therefore, geophysical, biological, or other types of disasters are not addressed. However, in the process of modifying the CDRI questionnaire, the principles stated in the HFA (UNISDR, 2007) are given more emphasis in order to be in line with international agreements (UNISDR, 2005) to spur the way for safer and more disaster resilient cities.

As it was introduced in the introduction part, the CDRI is not just an index, it also has wider ambitions in the form of an initiative where the objective is to function as an efficient planning tool. This means that the CDRI provides a baseline about the current condition of a particular urban area and the whole initiative includes further activities originating from this primary assessment.

As it was emphasized earlier, local authorities are the key target group for filling up the CDRI questionnaire. The reasons are that city governments cover most aspects of the CDRI questionnaire; for instance, the parameter health may be answered by the health department, or the accessibility of roads is maintained by another department within a city government. Of course, certain parameters cannot be answered by city officials as they are not necessarily dealt by the local government, like the provision of electricity or water, which can be organized/ provided by semi-private companies. Thus, data have to be retrieved individually from these organizations. However, the planning department is often the starting point for collecting the data from local governments, as seen in Fernandez et al.'s (in press) study (Metro Manila case study). This department in combination with the works department is likely to provide the majority of the responses. And these departments are also most eligible to take into account the findings from the CDRI assessment for further improved development of plans or action in order to address the deficits and needs adequately.

The listing of possible departments as sources for data and responses to the CDRI questionnaire obviously varies from city to city and also from the scope of research, like whether a city-wide assessment is undertaken or if the CDRI is applied at the microlevel (Gulsan et al., in press). In case the CDRI is applied at the microlevel, the local governments at zone or district level may have limited availability and accessibility to robust secondary data for the questionnaire; however, they are likely to have greater knowledge to understand the local context well and to provide "best choices" that serve the overall objective of this initiative to disclose the sectors where improvement is most needed in order to make the cities more resilient. The CDRI assessment and the initiative as a whole demonstrate a linkage between the academia, the local government, and to some extent the communities. Although current approaches in retrieving the data for the CDRI baseline assessment tend to be in rather close collaboration between the academia and local governments, the wider aim of this initiative is to engage communities, particularly in the process of developing and implementing sound measures (DRR) for improvement.

In the case studies, provided by Fernandez et al. (in press), Joerin et al. (in press), and Gulsan et al. (in press), the focus lies more in assessing the current conditions than on developing measures for improvement; nevertheless, it is understood that effective implementation measures need to be supported by the people and wider organizations (civil society). To conclude, key actors involved in this CDRI are numerous, ranging from the academia, local government, semi-private companies, communities,

to the civil society (NGOs). However, depending on the scale or scope of study, the involvement and number of partners may vary.

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CHAPTER 4

CLIMATE AND DISASTER RESILIENCE MAPPING AT NATIONAL LEVEL

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INTRODUCTION

In this chapter, the question posed is how the CDRI, applied at various cities spread across a country like India, can draw implications that are applicable for other cities in this country. The aim is to understand the risks, vulnerabilities, and capacities (resilience) of 12 Indian cities to respond to potential climate-related disasters. Surjan, Sharma, and Shaw (in press) highlight that particularly the Asian region is experiencing rapid urban growth, which is not only leading many cities to become megacities, with a population above 10 million, over the next decades (UN, 2010), but also making many smaller and middle-sized cities experience the phenomenon of urbanization (UNISDR, 2009). As it is perceived that more densely populated areas are at greater risk from potential disasters than the less populated ones, like rural areas/villages, cities require particular attention when it comes to reducing risks (UNISDR, 2009). Unplanned urbanization and poor urban governance are regarded as the two main underlying factors accelerating risk to disasters (UNISDR, 2009). The tool to assess the current condition and resilience of these 12 Indian cities is a contextualized CDRI

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addressing the Indian characteristics. In an era where climate change–related natural hazards (floods, storms, droughts, etc.) are expected to occur more frequently and with higher intensity (IPCC, 2007), Indian cities are becoming more vulnerable to such events (Revi, 2008).

The CDRI approach taken in this chapter has the objective to evaluate whether cities according to their location (riverside, coastal, mountainous, arid, and mixed) and size (small, medium, and large) in a country like India respond differently to climate-related disasters. The need to address disaster risks at national level is exemplified in the adoption of the Hyogo Framework for Action (HFA) in 2005, which highlights that mainstreaming of disaster risk reduction (DRR) is required at all special and institutional scales (UNISDR, 2005, 2007). The study, presented in this chapter, contributes to the understanding of how Indian cities can become more resilient to potential climate-related disasters.

This chapter is structured as follows: first, the need for climate disaster resilience mapping in Indian cities is explained by focusing on current socioeconomic, institutional, physical, and natural issues, which stress the functioning of many Indian cities; second, the results from measuring 12 Indian cities, using CDRI, emphasize the key problems and sectors where deficits hamper the resilience of these entities to potential climate-related disasters; third, the implications of these results may suggest how future planning of Indian cities can address key areas of problems; and finally, the significance and potentials of these results and findings are discussed.

NEED FOR CLIMATE DISASTER RESILIENCE MAPPING IN INDIAN CITIES

Current Socioeconomic Conditions in Urban Areas of India

It is highlighted that particularly Asian cities are experiencing rapid population growth, which not only challenges the functioning of cities' urban basic services and governance, but also has implications on the quality of urban ecosystems and the overall performance of cities (Surjan et al., in press). Furthermore, urbanization is seen as putting stress on these issues and causing risks that may increase the vulnerability of cities to potential disasters (Pelling, 2003; Satterthwaite, Huq, Pelling, Reid, & Romero-Lankao, 2007). In this chapter and particularly in this section, the focus is entirely on India and its socioeconomic and natural conditions in urban areas.

While India has still a low urbanization percentage, with currently only 29.7 percent (around 356 million) of the population living in urban areas, the population growth in many cities is more than 2 percent per year, which is above the global average of 1.76 percent or Indian average of 1.82 percent (UN, 2010). As a result, it is expected that by 2050, 875 million people or 54.2 percent of the total population will live in urban areas. Again, the expected average urban population growth rate of 1.82 percent for the period between 2010 and 2025 may not sound much; however, especially cities with a population above 100,000 (Class I) experience rapid growth (Government of India Planning Commission, 2008b). Accordingly, there is an observed concentration of growing populations in large cities and in urban agglomerations, but also varying trends within cities. Looking at Chennai, for example, the population growth rates in the inner and older parts of the city are well below 1 percent; however, along the urban fringe, the growth rates are between 2 and 3 percent per year (Chennai Metropolitan Development Authority (CMDA), 2008). This shall point out that population growth is not occurring homogenously throughout the city; nevertheless, Chennai, including, its agglomeration will become almost a megacity by 2025 with 9.9 million inhabitants (UN, 2010).

The consequences of this ongoing urbanization is officially recognized in the 11th five-year plan of the Government of India where it is regarded to lead to pressures on civic infrastructure systems, water supply, sewerage and drainage, uncollected waste, parks and open spaces, and transport. Moreover, the quality of many cities' environments is acknowledged to have deteriorated due to problems of traffic congestion, pollution, poverty, inadequate housing, crime, and social instability (Government of India Planning Commission, 2008a). A particular problem is the rising number of urban poor that stood at more than 80 million in a nation-wide survey in 2004–2005 or 25.7 percent of the total urban population (Government of India Planning Commission, 2008b). Accordingly, it is recognized that people living in slum and squatter settlements do not have sufficient access to drinking water and sewerage facilities are almost absent. In a nation-wide household survey in 1998, only 73 percent of households in Class I cities had access to drinking water; however, the smaller the town, the lesser the households have access to drinking water (NSSO, 1999). Similarly, the collection of solid waste is higher in metro cities with collection efficiency rates of 70–90 percent compared to around 50 percent in smaller towns (Government of India Planning Commission, 2008b). Although cities' basic urban services are under heavy pressure due to urbanization trends, cities are seen as the engine of economic growth and shall contribute up to 9–10 percent per year to the gross domestic product (GDP) (Government of India Planning Commission, 2008b). Currently urban areas contribute about

62–63 percent of the total GDP; it is expected to increase to 75 percent by 2021 (Government of India Planning Commission, 2008b). These various figures shall emphasize how much importance and weightage is given to urban areas in India, but also highlights the numerous challenges and risks to disasters, which cities are dealing with. Therefore, planning and policy-making must be an integrative approach to include all aspects of sustainability ranging from physical, social, economic, institutional, and environmental aspects (Government of India Planning Commission, 2008a).

Vulnerability of Indian Cities to Climate-Related Disasters

While the grade of exposure of many Indian cities is increasing due to impacts of urbanization, like unplanned development, increasing numbers of urban poor, etc., the question is whether they are also affected by climate change. Although it is expected that climate-related hazards become more frequent and more severe at global scale (IPCC, 2007), this trend cannot be confirmed so far for Indian cities. Studies from De, Dube, and Prakasa Rao (2005) do not show increases of natural hazards in the past century due to climate change rather than a decrease in numbers of cyclones in the Bay of Bengal. However, future predictions (scenarios) assume a rise in annual mean temperature between 3.5 and 5 or 2.5 and 4 degrees Celsius varying from different scenarios for the 21st century (Rupa Kumar et al., 2006). These temperature increases become amplified in urban areas due the urban metabolism, which adds to higher maximum and especially minimum temperatures (Kovats & Akhtar, 2008). Accordingly, heat waves and droughts are expected to have more severe consequences and would lead to increasing numbers of losses of human lives and rising health problems of people (Kovats & Akhtar, 2008; Revi, 2008). It is also predicted that there is a 20 percent rise in summer monsoon rainfall (July–September) for most parts of India, except for states like Rajasthan, Punjab, and Tamil Nadu, which may increase the occurrence of extreme weather events (Sathaye, Shukla, & Ravindranath, 2006). One of the latest extreme weather events was the flooding in Mumbai in 2005 in which around 1,000 people died due to heavy rainfalls (Revi, 2008). Within 24 hours, 944 mm of rainfall was recorded, which caused immediate flooding (Kovats & Akhtar, 2008). This disaster also demonstrated the limited availability of proper urban drainage systems in Mumbai, which is also the case for many other cities in India (Kovats & Akhtar, 2008). Moreover, the lack of catchment areas for large rainfall quantities, leading to flooding, may cause contamination of other water bodies with chemicals and other hazardous substances, which again lead to potential health problems of citizens. This is a

particular problem in urban areas where slums are often located near rivers and canals. Indirect impacts of climate change, like sea-level rise, is an additional stress for low-lying urban areas, like Chennai, Calcutta, and Mumbai, which may lead to salt water intrusion into groundwater bodies (Revi, 2008). Accordingly, besides major cities being located in these areas, more than 6 percent of India's population is living in low-elevation areas (McGranahan, Balk, & Anderson, 2007).

To conclude, various risk drivers, like impacts of urbanization and hydrometeorological hazards, are challenging the good functioning of Indian cities. As a result, vulnerability to climate-related disasters is increasing in urban areas of India. Therefore, addressing these risks and in addition the responsive capacity of urban areas (cities) by measuring them using the CDRI method (see Joerin & Shaw, in press) is the main objective of the following case studies. Reducing the risks to disasters is a necessary step to make cities safer and more resilient.

Commitment to HFA and Need for Implementation at Local Level

India, like many other nations, has adopted the HFA, which requires national governments to implement five key principles in relation to disaster risk reduction, as follows (UNISDR, 2007) (for further details, see Matsuoka & Shaw, in press):

- Making disaster risk reduction a priority
- Improving risk information and early warning
- Building a culture of safety and resilience
- Reducing the risks in the key sectors
- Strengthening preparedness for response

These principles may support the Government of India's own ambitious commitment in the 11th five-year plan to mainstream DRR into the process of sustainable development planning at all levels (Government of India Planning Commission Environment, 2008a). Thereby, the aspects of vulnerability, as set out in the previous sections, shall be considered in a comprehensive manner including social, ecological, organizational, educational, attitudinal, political, cultural, economical, and physical aspects. This progressive approach to recognize vulnerability to disasters not just as a physical or infrastructural problem is in line with the principles set out in the HFA (UNISDR, 2007). Since urban areas are recognized by the Government of India as fragile entities to potential disasters, special focus should be given to managing the risks at

this local level as problems are best understood at lower institutional scale (UNISDR, 2010a). An alliance of local governments for disaster risk reduction agreed in the "Incheon Declaration" (2009) that local governments are the first responder and the one responsible for community development and sustainable disaster risk reduction (UNISDR, 2010b). These arguments shall give sufficient ground to measure the vulnerabilities and associated risks in urban areas as a viable primary step for future disaster risk reduction.

MEASURING THE CDRI FOR INDIAN CITIES

City Characteristics and Selection

The previous sections have highlighted that Indian urban areas are highly vulnerable to potential climate-related disasters, but also that action for improvement is welcomed by the Government of India. In the following study, 12 Indian cities are assessed using the CDRI method, which is explained in Joerin and Shaw (in press). In collaboration with the National Institute of Disaster Management (NIDM) of India, the Town and Country Planning Organization, and SEEDS India, a study (Shaw et al., 2010) was conducted between August and September 2009 to gain data from 12 selected cities adopting the CDRI approach. Each municipality received a CDRI questionnaire and was requested to fill it up by consulting different departments within their institutional body. Fig. 1 shows the geographical location of the cities.

The 12 selected cities have varying topographical and geographical characteristics ranging from riverside, coastal, mountainous, arid, and mixed. Also the cities have different sizes of population, see Table 1.

In this study, the so-called CDRI approach was chosen to understand to what extent Indian cities are likely to be affected in case a climate-related hazard strikes. Aspects of vulnerability may reveal the fragility in the pre-event period, whereas resilience aspects define how the city is likely to cope with a disaster. Combining these two terms in one approach is a challenge, but is needed in order to serve the ultimate goal of making cities safer and more resilient for the future. Further explanations are given in Joerin and Shaw (in press).

Results of City Analysis

The results of this study, encompassing 12 Indian cities with different characteristics, are delivered in relation to three aspects: population,

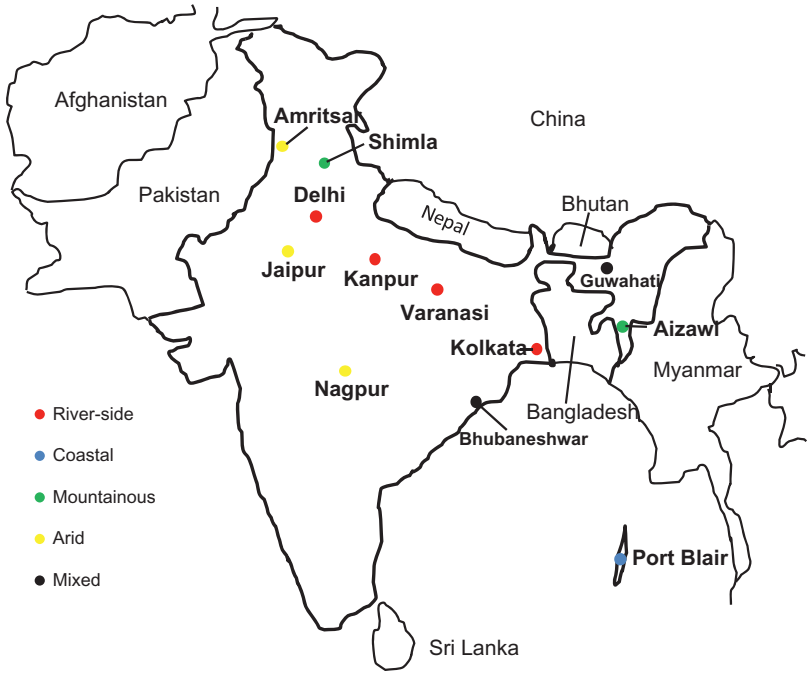

Fig. 1. Location of the 12 Indian Cities.

Table 1. Selected Cities for CDRI Study.

Size Aspect	Riverside	Coastal	Mountainous	Arid	Mixed
Small (up to 500,000)		Port Blair	Aizawl, Shimla		
Medium (500,000 to 3 million)	Kanpur, Varanasi			Amritsar, Jaipur, Nagpur	Bhubaneshwar, Guwahati
Large (more than 3 million)	Delhi, Kolkata				

location, and CDRI dimension, parameters, and variables. Three main questions shall be answered. The first question is whether bigger cities have higher CDRI scores than smaller ones. The second question tries to understand whether the location of cities has an impact on CDRI scores.

Table 2. CDRI Scores (Overall and Dimension-Wise) and Population Numbers of the Cities.

City	Population in Million	Physical	Social	Economic	Institutional	Natural	Overall
Delhi	13.78	3.84	3.08	2.44	2.84	3.52	3.14
Kolkata	4.57	4.16	3.68	2.42	3.48	3.40	3.43
Kanpur	2.72	3.36	3.16	2.52	3.60	3.12	3.15
Jaipur	2.32	4.04	3.32	2.44	2.76	3.08	3.13
Nagpur	2.13	4.32	4.22	2.76	3.88	3.76	3.79
Varanasi	1.20	2.99	3.14	2.52	2.58	3.08	2.86
Amritsar	1.00	3.36	2.60	2.40	2.08	3.12	2.71
Guwahati	0.82	3.68	3.52	2.44	3.04	4.07	3.35
Bhubaneshwar	0.66	3.24	2.60	2.60	2.93	3.24	2.92
Aizawl	0.23	3.16	4.24	2.24	2.36	2.56	2.91
Shimla	0.14	3.44	3.44	2.52	2.20	2.19	2.76
Port Blair	0.10	3.64	4.16	3.08	4.64	3.80	3.86

And the final question is which dimensions, parameters, and variables have lowest scores.

Population-Wise Results

To answer the first question, Table 2 shows the CDRI scores for all the dimensions in relation to the size of cities.

Looking at the overall scores in comparison to the population sizes of the cities, trends cannot be confirmed; for instance, larger cities have lower or higher CDRI scores. Correlation coefficients between the population size of the cities and the dimensions are not significant.

Location Characteristics

Since different cities are exposed to different types of hazard, for instance, cities located at the side of the Ganges River, like Kanpur or Varanasi, experience flooding as the main type of disaster. While mountainous cities are more affected by rainfall-induced landslides, the main hazard type for arid cities is drought. Table 3 presents the CDRI scores in relation to the location of the cities, and Fig. 2 maps out the CDRI scores for each city.

It is clear that conclusions out of the limited numbers of sample cities are difficult to draw; however, Table 3 shows that the two mountainous cities, Aizawl and Shimla, have a particular low CDRI score for the natural dimension. Both cities are located in hilly areas with steep slopes and experience yearly multiple rainfall-induced landslides, which may explain why

Table 3. CDRI Scores (Overall and Dimension-Wise) in Relation to the Location of the Cities.

Location	Cities	Physical	Social	Economic	Institutional	Natural	Overall
Riverside	Delhi, Kanpur, Kolkata, Varanasi	3.59	3.27	2.48	3.13	3.28	3.15
Coastal	Port Blair	3.64	4.16	3.08	4.64	3.80	3.86
Mountainous	Aizawl, Shimla	3.30	3.84	2.38	2.28	**2.37**	2.83
Arid	Amritsar, Jaipur, Nagpur	3.91	3.38	2.53	2.91	3.32	3.21
Mixed	Bhubaneshwar, Guwahati	3.46	3.06	2.52	2.99	3.66	3.14

their natural CDRI score is relatively low compared to other cities located in more flat areas.

Dimension and Parameter-Wise Characteristics

In this section, CDRI scores are analyzed in more detail and aim to answer the third question outlined earlier. Combining all the scores from the 25 variables per dimension and then multiplying by 12 cities gives a total number of 300 data per dimension, which increases markedly the significance for dimension-wise average scores. Table 4 and Fig. 2 highlight that the physical dimension is highest performing and that the economic dimension is the lowest. While the physical and economic scores are similar for most cities (low range of deviation), the average scores for the social, institutional, and natural dimensions vary between cities (see Fig. 3, overall); especially the institutional dimension shows large variations. The differences in terms of variation between cities are likely due to the higher number of subjective variables in the social, institutional, and natural dimensions compared to the physical and economic dimensions, which rely to a larger extent on quantitative data.

Another question must be answered: whether the dimensions show correlations between themselves. Table 5 shows that few dimensions correlate with each other significantly; however, the economic and institutional dimensions demonstrate a quite high correlation of $r = 0.79$. This means that the higher the economic score of a city, the higher the institutional value. In other words, higher availability of economic resources for communities and the municipality may support the functioning of the institutional governance before and during a potential disaster.

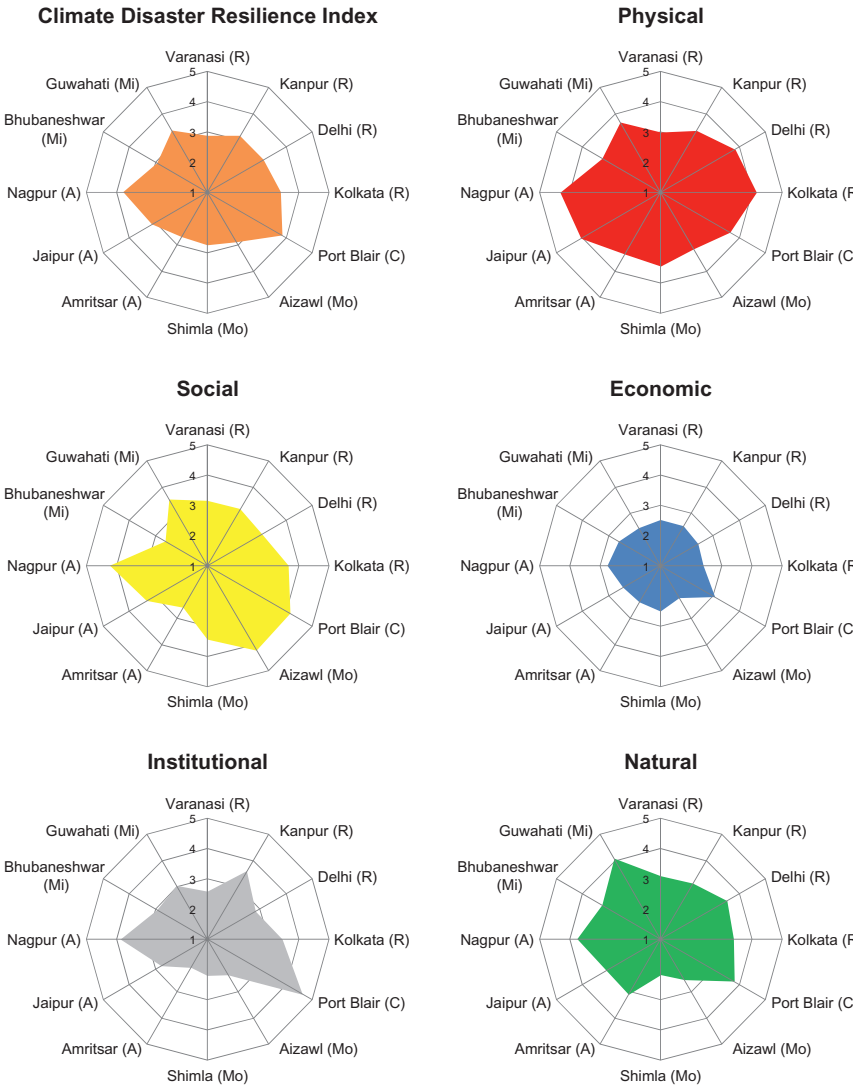

Fig. 2. Climate and Disaster Resilience Mapping (CDRM) of CDRI Scores for All the Cities.

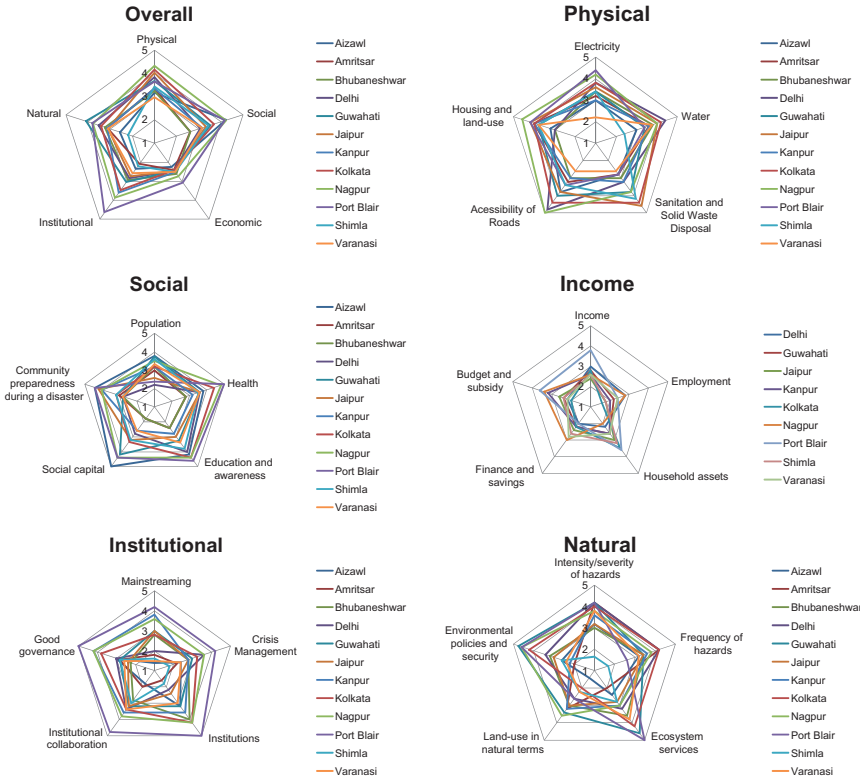

Fig. 3. CDRI Scores: Dimension- and Parameter-Wise.

Table 4. Average CDRI Scores (Dimension-Wise) for All the Cities.

City	Physical	Social	Economic	Institutional	Natural	Overall
All cities	3.60	3.43	2.53	3.03	3.24	3.17

Table 5. Correlation Coefficients between the Five Dimensions.

Physical and Social	Physical and Economic	Physical and Institutional	Physical and Natural	Social and Economic	Social and Institutional	Social and Natural	Economic and Institutional	Economic and Natural	Institutional and Natural
0.38	0.20	0.46	0.49	0.31	0.50	0.14	0.79	0.45	0.66

In the following paragraphs, the composition and influence of parameters within the dimensions are analyzed dimension-wise (see Fig. 3). This throws more light at the understanding of the CDRI approach, which is a complex index consisting of a plethora of different aspects.

Physical: Although the average score is highest (see Table 4) among the five dimensions and the average range is little between the cities, the detailed spider diagram needs to be further looked at in Fig. 3. Here, the physical dimension shows large variations between the parameters; for instance, accessibility of roads has large differences between the cities whereas housing and land use have similar scores for most of them. Another example highlighting the need for detailed analysis is the fact that Delhi has very good accessibility of roads and highest provision of water, but below-average sanitation and solid waste disposal. Nevertheless, the spider form is similar for most cities.

Social: There is large variation between health, education and awareness, social capital, and community preparedness to disasters, but relatively little within the population parameter. However, cities have harmonious spider diagrams dominated by the population parameter, which has no scores above 4. This is unlike social capital, which ranges from below 2 up to 5. Once again, the population parameter is represented by more quantitative data in contrast to social capital.

Economic: The score of the economic dimension deviates clearly from the scores of other dimensions and is lowest among them. Looking at the shape of the economic dimension (Fig. 3), there is little difference in the range of scores between the five parameters. Thus, a low economic score of a city is influenced by all five parameters. The reason for this generally low economic condition is limited availability for communities to generate income (low employment levels), which as a result reduces their opportunities to accumulate wealth in the form of household assets. And as a consequence, they have reduced capacities to provide themselves and the government with money that could serve them before a disaster with financing protection measures and after the event with relief and rehabilitation activities. The results in the economic dimension show well the interlinkages between the different parameters, emphasizing that an isolated interpretation of either an entire CDRI dimension or an individual parameter is not suggestible.

Institutional: The institutional dimension is characterized by large variations between cities, ranging from high to low. This is likely again due to the large number of variables that require a subjective interpretation, but it also shows that all the parameters are linked to each other. Good

crisis management is followed by well-functioning institutional collaboration or mainstreaming of DRR and CCA into development plans. However, this large ambiguity (see Fig. 2) between cities' institutional performances underlines that the CDRI approach is heavily challenged to understand institutional processes adequately.

Natural: The natural dimension points out that it is mixed with different types of parameters that are not related to each other; thus, low numbers or severity of natural hazards does not mean that environmental policies are well implemented, like in Varanasi (see Fig. 3). Unfortunately, the CDRI does not confirm the assumption that intense land use leads to a lower quality of a city's ecosystem; it rather shows the opposite. However, a clear trend cannot be found to confirm that understanding the CDRI requires detailed city-wise interpretation

The interpretation of the CDRI scores is a real challenge; however, Table 6 aims to clarify the question which parameters are highest or lowest and those that do not require improvements and others that need most. Since the economic dimension is lowest in average, it is not surprising that within the last seven parameters, all the economic parameters are ranging with the absolute lowest score for the parameter ''Employment.''

Table 6. Average CDRI Scores (Parameter-Wise) for All the Cities.

Parameter	Highest to Lowest	Parameter	Highest to Lowest
Housing and land use	3.8	Good governance	3.24
Health	3.73	Knowledge dissemination	3.2
Accessibility of roads	3.7	Institutional collaborations	3.2
Water	3.63	Population	3.15
Intensity of natural hazards	3.59	Crisis management	2.9
Education and awareness	3.55	Income	2.75
Community preparedness	3.47	Land use	2.7
Electricity	3.45	Household assets	2.68
Sanitation and solid waste	3.43	Mainstreaming of DRR and CCA	2.63
Frequency of natural hazards	3.41	Budget and subsidy	2.58
Ecosystem services	3.37	Finance and savings	2.38
Environmental policies	3.29	Employment	2.28
Social capital	3.28		

DISCUSSION AND IMPLICATIONS OF FINDINGS

Implications for Indian Cities

The CDRI assessment of 12 Indian cities revealed several findings that confirm the problems listed; for example, the ongoing urbanization trend in many Indian cities is reflected in the social dimension where the population parameter tends to be lower than other parameters (see Fig. 3) in this dimension. The impacts of urbanization may also be seen in the relatively low score of the land-use parameter (see Fig. 3 and Table 6). As this parameter reflects the loss of urban green space, and intensity of land use, it confirms that urbanization is actually taking place; however, to assume that the ecosystem would be harmed due to this phenomenon cannot be confirmed.

Regarding the economic dimension (Fig. 3), the CDRI results highlight that this dimension has lowest CDRI scores within the five dimensions. The reason for this lies in the relatively low average per capita income of India compared to other countries in the Asian region. Although urban areas (Government of India Planning Commission, 2008b) in India have higher average incomes than rural areas, these incomes are still lower than in other countries, like the Philippines or Thailand. Therefore, the CDRI score for the economic dimension may not mean that the economic growth in the cities is not occurring, but rather exemplifies that the level of economic wealth is still relatively low.

Looking at the natural dimension, cities in mountainous areas (see Fig. 2) seem to be particularly affected by frequently occurring rainfall-induced landslides, as shown by Aizawl and Shimla; although drawing conclusions based on two samples may not be significant, the deviation away from other cities' CDRI scores may point out that mountainous areas are experiencing disasters more intensely. Moreover, Table 3 highlights that the physical, economic, and institutional scores of these two cities are also lowest in an aggregated average form compared to the riverside, coastal, arid, or mixed cities. However, it should not be argued that all mountainous cities are likely to have reduced score in these dimensions, but rather attention is needed for the relatively high social score that underpins that high vulnerability and occurrence of climate-related disasters are not associated with social aspects of a city. Thus, it is suggested that communities' ability to respond to a climate-related disaster is not related to the availability of physical infrastructure, good governmental leadership, or economic strength.

Towards Taking Action

The previous sections illustrated how challenging the measuring of vulnerability and resilience aspects of cities is to adequately draw conclusions. The limited number of other comparable indexes (see Joerin & Shaw, in press) denies a comparison of CDRI scores; therefore, the interpretation of the scores has to follow the purpose of identifying vulnerable sectors that have limited capacity to respond to a potential disaster event. Furthermore, aiming for conclusions for the overall situation of Indian cities based on the limited number of 12 samples is not suggestible. While the key actor to take major actions would be the Government of India followed by this type of India-focused city disaster resilience study, it would likely require larger institutional bodies, like SAARC or ASEAN, to implement similar studies and actions at the regional level. It must be emphasized that the CDRI can be adopted at different geographical and institutional scales ranging from local, city-cluster, national, and regional if modified to the respective context. The following chapters focus on how adaptation measures can be planned into concrete actions (Fernandez, Takeuchi, & Shaw, in press), how the communities can be involved to adapt and reduce the risks (Parashar et al., in press), and also how the international policy framework named HFA can support actions at the local level (Matsuoka & Shaw, in press).

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CHAPTER 5

CLIMATE AND DISASTER RESILIENCE MAPPING IN CITY CLUSTERS

Glenn Fernandez, Yukiko Takeuchi and Rajib Shaw

INTRODUCTION

In recent years, several studies have focused on city clusters like megacities and mega urban areas, as they concentrate a significant part of the world's human population and critical economic assets in potentially hazardous locations (Yusuf, 2007; WWF, 2009; Kraas, 2007; Jones, 2009). Metro Manila is one of such megacities, where even "regular" disasters affect a large number of people. The rapid pace of urbanization, coupled with an ever-increasing population burden, has significantly increased the overall vulnerability of urban agglomerations to natural disasters. By 2050, world population is expected to reach 9 billion people. Large numbers of people will be concentrated in megacities and on fragile lands, making the reduction of vulnerability to disasters in metropolitan areas a critical challenge facing development. Unmanaged rapid urban growth strains the capacity of national and local governments to provide even the most basic of services such as health, food, shelter, employment, and education. The challenge then is for the national government and most especially the local governments to develop effective policies, programs, and strategies that will help them manage urbanization to ensure development.

In the Philippines, rapid urbanization has occurred only in the last four or five decades, when many rural dwellers trooped to urban centers such as Metro

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Manila and Metro Cebu in search for the proverbial good fortune and good life (POPCOM, 2004). The major cities provide countless opportunities for economic development. Urban areas serve as the industrial, commercial, and administrative centers in the different regions of the country. Urban centers also represent availability and accessibility to various services and facilities. Often, however, urbanization occurs at such a rapid pace that cities are not able or not equipped to manage the attendant concerns.

Climate change will increase the hazard potential in many cities. Although climate change will affect everyone, developing countries like the Philippines will be hit the hardest and soonest and will have the least capacity to respond (WWF, 2009). Climate change is happening now in the Philippines and the rest of Southeast Asia, and the worst is yet to come. The frequency and intensity of extreme weather events have also increased in recent years. This includes a significant increase in the number of heavy precipitation events and an increase in the number of tropical cyclones. In 2009, these climatic changes have led to massive flooding in many parts of the region, like the Philippines, Vietnam, Cambodia, and Thailand, causing extensive damage to property, assets, and human life, especially in the cities. Throughout history, cities have adapted to climate variability, but the intensity and pace of the present and forthcoming climate changes induced by the continued and ongoing emission of greenhouse gases are already, and will increasingly be, a major challenge to many of them. Urban communities are dependent on the infrastructures that supply them with essential services such as clean water, waste management, electricity, transportation, and telecommunications. Climate change threatens these critical infrastructures and they must be protected. If not addressed adequately, climate change could seriously impede the sustainable development of cities and their poverty eradication efforts.

CATEGORIES OF CITY CLUSTERS

There are several types of city clusters, and each type may have several definitions (Kraas, 2007; Munich Re, 2004). It is also difficult to estimate the population of the world's biggest cities for several reasons, like varying definition of cities, varying city boundaries used, frequency and accuracy of censuses, and varying rates of population change (Wisner, 2003). According to the Asian Development Bank (2009), "city cluster development is a process of economic and social development through which the built-up areas of a number of human settlements become linked together functionally, structurally, and spatially to form an integrated urban region." City clusters happen

when the territorial expanse of a number of bordering cities extend until they produce an urban corridor, as in the Tokyo–Nagoya–Yokohama–Osaka–Kyoto–Kobe Shinkansen, or "bullet train," conurbation in Japan.

Recently, the megacity has been the most researched city cluster. A megacity is usually defined as a metropolitan area with a total population in excess of 10 million people. The number of megacities is expected to reach 27 in 2025 (UN Population Division, 2008). Today, the biggest megacity, Tokyo, already has more than 35 million inhabitants, which is greater than the entire population of Canada at 33.8 million (CIA, 2010). City clusters can result from the expansion of a megacity that enfolds adjoining small and medium-sized cities to form a mega-urban region (MUR). It is expected that by 2020, two-thirds of the entire population in Southeast Asia will live in only five MURs: the Bangkok-centered MUR (30 million), the Kuala Lumpur–Klang MUR (6 million), the Singapore Triangle (10 million), the Java MUR (100 million), and the Manila MUR (30 million) (UN Habitat, 2004). City clusters may also take the form of a subnational city cluster made up of large and medium-sized cities in which no one city is dominant, as in the Guangzhou–Shenzhen–Hong Kong–Macau Pearl River Delta region in the People's Republic of China (Yeh et al., 2002, cited in

Table 1. Definition of Terms.

City Cluster	Characteristics
Megacity	an urban agglomeration with at least 10 million inhabitants (UN Population Division, 2008)
Urban agglomeration	agglomeration comprising a city or town proper and also the suburban fringe or thickly settled territory lying outside of, but adjacent to, the city boundaries (UNESCAP, 2010)
Metropolitan area	the aggregate geographic area inclusive of not only a well-known city population but also its inner city, suburban, exurban, and sometimes rural surrounding populations, all of which are influenced by employment, transportation, and commerce of the more largely well known urban city
Conurbation	a region comprising a number of cities, large towns, and other urban areas that, through population growth and physical expansion, have merged to form one continuous urban and industrially developed area (a metropolitan area consists of a central city and its suburbs while a conurbation consists of adjacent metropolitan areas that are connected with one another by urbanization)
Mega-urban region	the broader region comprising the officially defined metropolitan area and zones outside it that are functionally linked to it as extensions of its builtup area (termed the inner zone) or in the early stages of experiencing transformation of employment, infrastructure, industrial, and commercial development tied to the metropolis (Jones, 2009)

Table 2. World's 20 Largest Urban Agglomerations, 2007 and 2025.

Rank	2007		2025	
	Urban Agglomeration	Population (Thousands)	Urban Agglomeration	Population (Thousands)
1	Tokyo	35,676	Tokyo	36,400
2	New York–Newark	19,040	Mumbai	26,385
3	Mexico City	19,028	Delhi	22,498
4	Mumbai	18,978	Dhaka	22,015
5	Sao Paulo	18,845	Sao Paulo	21,428
6	Delhi	15,926	Mexico City	21,009
7	Shanghai	14,987	New York–Newark	20,628
8	Kolkata	14,787	Kolkata	20,560
9	Dhaka	13,485	Shanghai	19,412
10	Buenos Aires	12,795	Karachi	19,095
11	Los Angeles–Long Beach–Santa Ana	12,500	Kinshasa	16,762
			Lagos	15,796
12	Karachi	12,130	Cairo	15,561
13	Cairo	11,893	Metro Manila	14,808
14	Rio de Janeiro	11,748	Beijing	14,545
15	Osaka–Kobe	11,294	Buenos Aires	13,768
16	Beijing	11,106	Los Angeles-Long Beach–Santa Ana	13,672
17	Metro Manila	11,100		
18	Moscow	10,452	Rio de Janeiro	13,413
19	Istanbul	10,061	Jakarta	12,363
20	Paris	9,904	Istanbul	12,102

Source: UN Population Division (2008).

ADB, 2009). Some city clusters have small cities that act as service centers for small towns, as in the Naga–Legaspi–Iriga–Daet city cluster in the Philippines (Mangahas, 2006, cited in ADB, 2009). Finally, some transborder city clusters have adjoining cities located in separate nation-states that pursue common development initiatives, as in the Singapore–Johor–Riau "growth triangle" in Southeast Asia (Macleod and McGee, cited in ADB, 2009) (Tables 1 and 2).

METRO MANILA CITY CLUSTER

Metro Manila Profile

According to a 2009 publication of the World Wide Fund for Nature (WWF), among the coastal megacities of Asia, Metro Manila, Philippines,

tied with Jakarta, Indonesia, as the second most vulnerable to climate change, after Dhaka, Bangladesh. In the comparison of exposure to climate impacts, Metro Manila is the most at risk of the 11 megacities examined by WWF, largely because of its exposure to tropical cyclones and flooding. Metro Manila, also known as the National Capital Region, is one of the largest urban agglomerations in the world. This rapidly growing urban center continues to attract people from all the other regions of the country. Its land area (638.55 sq km) is approximately just 0.21% of the entire Philippines. Based on the 2007 census, the total population of Metro Manila is 11,553,427, which accounts for 13% of the country's total population (Fig. 1, Table 3). The population of Metro Manila is predominantly young. Approximately 29.4% are between 0 and 14 years of age, while 3.7% are 65 years old and above. The economic reproductive age ranging from 15 to 64 years accounts for 67.05%. The average household size is 5.

As a rapidly urbanizing region, Metro Manila is faced with many challenges. Its unplanned growth in response to socioeconomic demands and rapid population growth due to migration and births have increased pressures on the capacity of the region and the delivery of basic services, such as health. These are

Fig. 1. Map of Metro Manila.

Table 3. Demographics of Metro Manila.

	Area (Sq Km)	Population (2007)	Population Density	Annual Population Growth Rate (%)
Caloocan	53.33	1,378,856	25,855	2.20
Las Piñas	41.54	532,330	12,815	1.65
Makati	27.36	510,383	18,654	1.91
Malabon	15.76	363,681	23,076	0.98
Mandaluyong	11.26	305,576	27,138	1.29
Manila	38.55	1,660,714	43,079	0.68
Marikina	33.97	424,610	12,500	1.14
Muntinlupa	46.70	452,943	9,699	2.48
Navotas	10.77	245,344	22,780	0.87
Parañaque	47.69	552,660	11,589	2.88
Pasay	19.00	403,064	21,214	1.77
Pasig	31.00	617,301	19,913	2.80
Pateros	2.10	61,940	29,495	1.05
Quezon	161.12	2,679,450	16,630	2.92
San Juan	5.94	124,187	20,907	0.87
Taguig	47.88	613,343	12,810	3.82
Valenzuela	44.58	568,928	12,762	2.21
Total	638.55	11,553,427	18,093	2.11

Source: National Statistics Office (2007).

Table 4. Characteristics of Metro Manila.

Age since foundation (years)	430
Situation	Coastal peninsulas between bays
Topography	Coastal plain, river flood plain, hilly to the east
Climate	Tropical
Political and economic importance	Nationally primate and subregional economic role in Asia
Percentage poor	50
Percentage in informal settlement	30
Natural hazards	Earthquake, flood, landslide, typhoon
Last major disasters	Typhoon Ketsana and Typhoon Parma in 2009

Source: Wisner (2003).

manifested in urban challenges that Metro Manila faces such as traffic, housing, unemployment, communicable and noncommunicable diseases, pollution, garbage, and peace and order. Since Metro Manila is the political, economic, social, and cultural center of the Philippines, its protection from climate-related

disasters is of utmost importance. Development gains are being jeopardized by increasing losses due to hydrometeorological disasters (Table 4).

CDRI STUDY RESULTS

In this present study, CDRI is again used to evaluate the current level of climate disaster resilience of the 16 cities and 1 municipality (hereafter collectively referred to as "the cities") of Metro Manila, one of the largest urban agglomerations in the world (Shaw, Takeuchi, & Fernandez, 2010). The survey respondents were the planning officers of each city of Metro Manila. The distribution of the questionnaire was facilitated by the secretariat of the Metro Manila Planning and Development Officers' Association (Metroplanado), a nongovernment organization (NGO) of city/municipal development planning officers from Metro Manila, which was organized in 1991 to assist local government units (LGUs) in the formulation of the general master plan for the metropolis. The association aims to establish, promote, and institutionalize planning as an effective mechanism for an organized, systematic, and well-planned urban development process. It took two months to collect all 17 completed questionnaires. By applying a holistic approach considering five dimensions to address disaster risk reduction (DRR) and climate change adaptation (CCA) and by facilitating action planning, it is hoped that this initiative can contribute in helping cities and residents of Metro Manila become more resilient when disaster strikes and become better able to protect their lives, livelihoods, and assets.

Strengths and Weaknesses of the Cities

From the questionnaires, it was observed that there are variables consistently rated either very high or very low by the planning officers. The variables with the high ratings (with average equal to or greater than 4.85 out of 5) can be considered the strengths of the cities, while those with low ratings (with average less than 2.00 out of 5) the weaknesses of the cities (Tables 5 and 6).

As the country's socioeconomic center, Metro Manila enjoys an almost uninterrupted power supply. This implies that the residents of Metro Manila can get continuous updates on weather and disaster information from their television and radio. As early warning information is a significant part of disaster preparedness, the cities are correct in saying that adequate supply of

Table 5. Variables Rated "Very High" by the Planning Officers.

Variable	Rating
2.1.1 Percentage of the city population with legal access to electricity from electric companies	5.00
2.1.3 Electricity supply authority capable to supply the city's demand for electricity	5.00
2.3.3 Collection of solid waste produced per day	4.93
2.1.2 Status of power supply interruption (status of daily availability of electricity)	4.86
2.4.3 Percentage of roads that remain accessible during normal flooding (e.g., after a heavy rain, during high tide, etc.) in affected areas	4.86
3.2.1 Percentage of city dwellers that suffer from waterborne or vector-borne diseases every year	4.85
3.2.3 Functionality of internal primary health services after most frequent disasters (i.e., floods and typhoons)	4.85

Table 6. Variables Rated "Very Low" by the Planning Officers.

Variable	Rating
6.2.2 Frequency of typhoons	1.38
6.4.2 Intensity of land use – urban morphology (level of urbanization; extent of urbanized areas)	1.69
6.2.1 Frequency of floods	1.77

electricity is one of their strengths in building disaster resilience. Garbage collection by the cities and by the Metro Manila Development Authority (MMDA) has also improved tremendously compared to in the past. Postdisaster debris, especially road and drainage obstructions, are cleared up immediately and traffic is restored to normal in a short period of time, allowing roads to become passable again and making floodwaters recede faster due to well-maintained drainage systems. The only exception was when Typhoon Ketsana *(Ondoy)* hit Metro Manila in September 2009. The coping capacity of some cities, like Marikina and Pasig, was overwhelmed by the massive destruction caused by the once-in-a-lifetime flooding, so it took several weeks to complete the cleanup and recovery efforts. This is the reason why all the cities agree that the frequency of typhoons and floods as well as the level of urban morphology is their weakness. Natural hazards are out of their control, while urbanization has gone out of control due to poor planning, poor implementation of building codes, and spread of the built

environment in hazardous areas like along coasts and rivers. These weaknesses negatively affect the disaster resilience of cities in Metro Manila.

Indicators Most and Least Important to the Cities

Similarly, it was observed that there are variables consistently ranked either very high or very low, according to their perceived importance to the cities. The variables with high ranking (with average greater than 4.50 out of 5) are the those that are most important to the cities, while those with low ranking (with average less than 1.50 out of 5) are least important to the cities.

As can be seen in Tables 7 and 8, the cities of Metro Manila are very concerned about their level of poverty and their disaster management plan, and they believe these are very important variables in the measurement of climate disaster resilience. On the other hand, the cities think that access to the Internet at home is not very relevant as the cities' main sources of weather and disaster information are still the television and radio. As most

Table 7. Variables Ranked "Very High" by the Planning Officers.

Variable	Rating
4.1.1 Percentage of the city's population that live below the poverty line	4.92
5.2.1 Existence and effectiveness of the city's disaster management plan	4.92
4.3.1 Percentage of the city's households that have television or radio	4.58
5.5.1 Integration and implementation of disaster risk management plans/policies	4.58

Table 8. Variables Ranked "Very Low" by the Planning Officers.

Variable	Rating
3.3.4 City's average population that has access to the Internet at home	1.23
2.2.4 City's water supply dependent on external provision (e.g., from other cities/areas) during most frequent disasters	1.31
2.1.4 City's electric supply dependent on external provision (e.g., from other cities/areas) during most frequent disasters	1.42
5.2.5 Existence and readiness of alternate/backup decision-making personnel during a disaster (e.g., the head decision maker is out of the country)	1.42

of Metro Manila's power and water supply are already from outside the region, variables 2.2.4 and 2.1.4 are considered not very relevant in the context of Metro Manila.

Summary of Findings per Dimension

Based on the CDRI computed from the questionnaires filled out by planning officers, Metro Manila has high physical (4.37), institutional (4.25), and social (4.03) resilience and moderate natural (3.15) and economic (3.13) resilience. Its overall CDRI is 3.78 out of a perfect score of 5. Table 9 shows the CDRI score of each of the 17 cities in each of the five dimensions assessed in this study.

Table 9. Summary of CDRI Scores per Dimension.

Cities	Five Dimensions of Climate Disaster Resilience				
	Physical	Social	Economic	Institutional	Natural
Caloocan	High	Moderate	Low	High	Moderate
Las Piñas	High	High	Moderate	Moderate	Moderate
Makati	High	High	Moderate	High	Moderate
Malabon	Moderate	Low	Low	Moderate	Low
Mandaluyong	High	High	Moderate	High	Moderate
Manila	High	High	Moderate	Moderate	Moderate
Marikina	High	Moderate	Moderate	Moderate	Moderate
Muntinlupa	High	High	Moderate	High	Moderate
Navotas	High	High	Low	High	High
Parañaque	High	High	Moderate	High	Moderate
Pasay	High	Moderate	Low	High	Low
Pasig	High	High	Moderate	High	Low
Pateros	High	Moderate	Low	Moderate	Moderate
Quezon City	High	Moderate	Moderate	Moderate	Low
San Juan	High	Moderate	Moderate	Moderate	Low
Taguig	High	High	Moderate	High	Low
Valenzuela	High	Moderate	Moderate	High	Low
	High = 16	High = 9	High = 0	High = 10	High = 1
	Moderate = 1	Moderate = 7	Moderate = 12	Moderate = 7	Moderate = 9
	Low = 0	Low = 1	Low = 5	Low = 0	Low = 6

High: 4.00–5.00; moderate: 3.01–3.99; low: 1.00–3.00.

CITY ANALYSIS AND POLICY IMPLICATIONS TO THE HFA PRIORITIES FOR ACTION

Cities in city clusters differ from each other in terms of priorities and long-term needs such that in each city different sets of tasks need to be undertaken ahead of others. Cities and their residents must participate actively in DRR. They must have a stake in protecting themselves and not just leave the job to the national government. Thus, aside from reporting the current level of climate disaster resilience of the cities of Metro Manila and their performance in the physical, social, economic, institutional, and natural dimensions, there is a section on policy implications in relation to the Hyogo Framework of Action (HFA) at the end of each city report. This portion lists some suggestions for localized implementation of the five priorities for action: making DRR a priority (governance), improving risk information and early warning (risk assessment and early warning system), building a culture of safety and resilience (knowledge management), reducing the risks in key sectors (vulnerability reduction), and strengthening preparedness for response (disaster preparedness). It is hoped that these suggestions can be a catalyst for initiating action and delivering meaningful results at the city level. The list is admittedly not exhaustive but should be useful enough in providing a starting point for the cities. The CDRI analysis result shows Mandaluyong and Malabon as the most and least resilient city in Metro Manila, respectively (Fig. 2). To exemplify the contributing factors that led to this ranking and what local actions can be performed by each city, detailed analyses of the two cities are presented. Graphs are provided to help visualize the analysis results and to facilitate comparison between dimensions and between the two cities (Figs. 3 and 4). One graph shows the city's overall resilience and five other graphs demonstrate the city's resilience in terms of the physical, social, economic, institutional, and natural aspects.

Mandaluyong City Analysis

Mandaluyong lies at the heart of Metro Manila. Mandaluyong's remarkable rate of development since the early 1980s established the city as one of the most progressive economic centers in the country. Now it is the third most densely populated city in Metro Manila and has the second highest GDP per capita. No less than the World Bank has rated Mandaluyong as the most business-friendly city in the Philippines in terms of registering property in its recent *Doing Business Report*. In addition, the Asian Institute of Management Policy

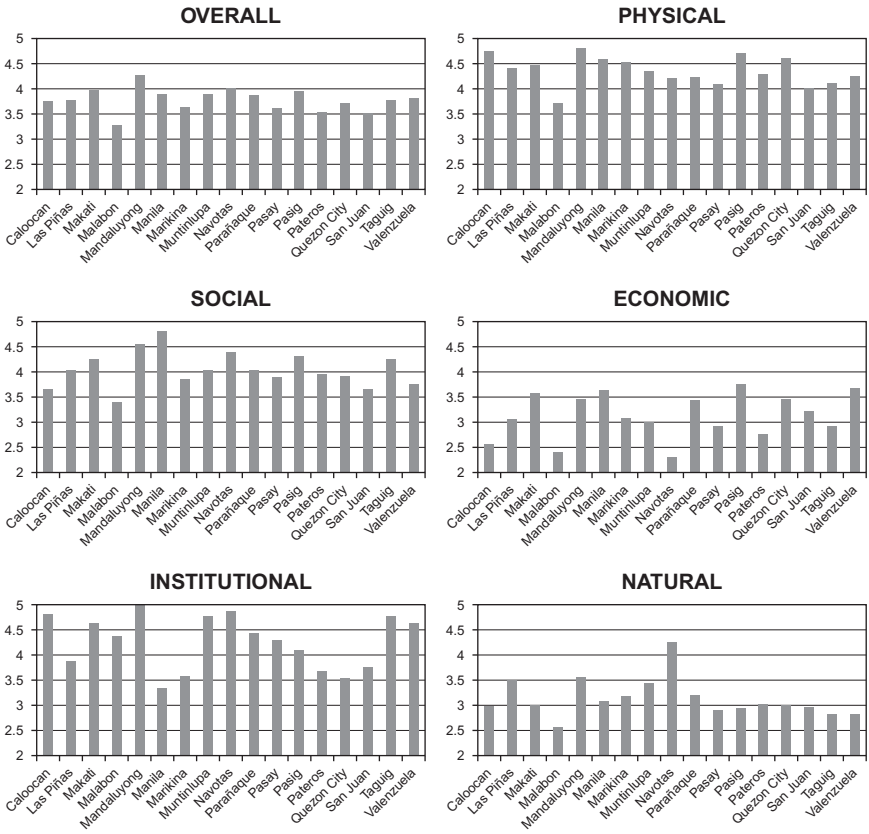

Fig. 2. CDRI of the Cities and Municipality of Metro Manila.

Center conferred Mandaluyong as ''Best in Quality of Life'' in its latest city competitiveness study. At present, Mandaluyong is dubbed as the ''Tiger City of the Philippines.'' The headquarters of the Asian Development Bank is located in Mandaluyong.

Physical: Among the cities of Metro Manila, Mandaluyong has the highest score in the physical dimension (4.81 out of 5). It has a perfect score in electricity and water. Its weakest point is sanitation and solid waste disposal. Mandaluyong generates about 1,200 cubic meters of solid waste per day, a combination of domestic, commercial/industrial, and institutional/hospital wastes. Each resident generates approximately 0.71 kg of solid waste per day, which is beyond the standard range of 0.23–0.60 kg or an average of 0.40 kg

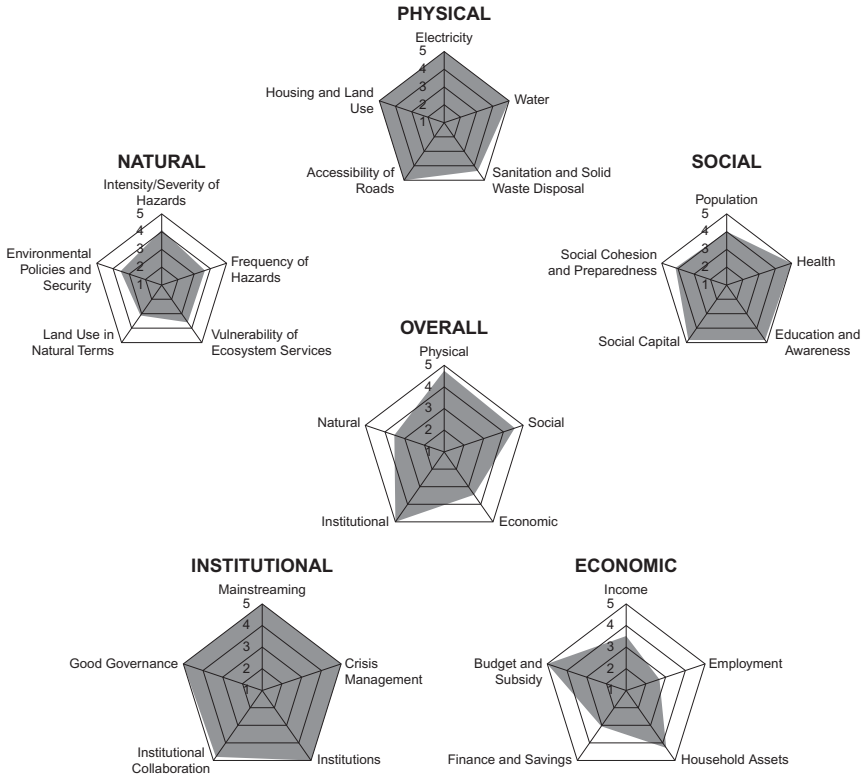

Fig. 3. Resilience Map of Mandaluyong City.

per capita per day as indicated in several studies in Metro Manila. One contributing factor to such increase is the intensive use of disposable materials in lieu of reusable day-to-day items such as food containers, kitchen utensils, personal paraphernalia, and the like, as can easily be observed from filled garbage bins and street litter.

Social: Despite having the third highest population density in Metro Manila at 27,138 per sq km, Mandaluyong has the second highest score in the social dimension. It has a very high score in health, education and awareness, and social capital. The peace and order situation of the city, the status of its residents' well-being, and its environmental preservation initiatives are among the best in the region.

Economic: Typical of cities in metropolitan areas, Mandaluyong has its own share of commercial strips and a central business district. Mandaluyong

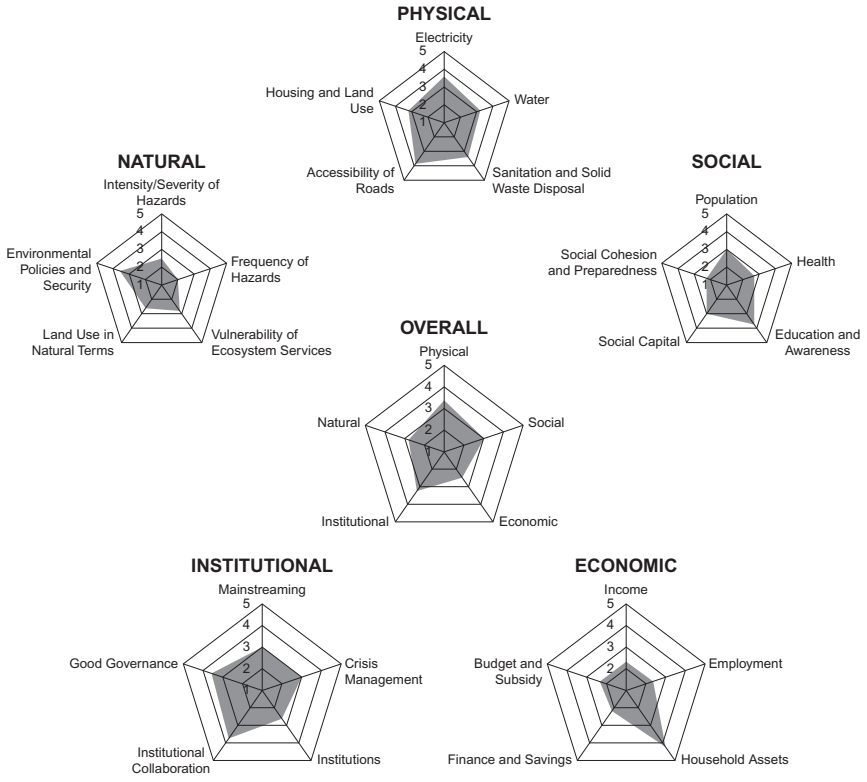

Fig. 4. Resilience Map of Malabon City.

is host to establishments such as the SM Megamall, one of the largest malls in the world; Edsa Shangri-La Hotel, a five-star hotel; high-end shopping centers like The Podium; and one of Southeast Asia's biggest food and beverage companies, the San Miguel Corporation. With its revenues, Mandaluyong is one of the few cities with more than 7.5% of its annual budget targeted on DRR efforts. Consequently, it has a high score in budget and subsidy. In addition, in response to the strengthening of global advocacy toward full protection and recognition of the rights of workers in the informal sector, the city government created the City Informal Sector Office.

Institutional: Among the cities of Metro Manila, Mandaluyong has the highest score in the institutional dimension (almost perfect score of 4.99 out of 5). It has a perfect score in four out of five parameters: mainstreaming of DRR and climate change adaptation, effectiveness of city's crisis

management framework, effectiveness of city's institutions to respond to a disaster, and good governance.

Natural: Among the cities of Metro Manila, Mandaluyong has the second highest natural resilience. The city has a low score in land use in natural terms and in vulnerability of ecosystem services. The frequency of floods is high. The quality of urban water in rivers, creeks, and canals is low. And there are settlements located in flood-prone areas, increasing the city's vulnerability exposure. Typhoons during the wet season greatly affect the city and the rest of Metro Manila. Damage to property and risk of lives are among the major effects of typhoon. Secondary to these are the flash floods that severely affect the lowland areas. Heavy rains, even of short duration, result in flooding in some areas of Mandaluyong, especially in barangays (villages) lining the coasts of the Pasig and San Juan Rivers.

The following paragraphs discuss the five HFA priorities and what Mandaluyong needs to accomplish under each priority based on the CDRI analysis results. These policy points and recommendations are suggested to provide encouragement to the city government's engagement in specific institution and capacity building.

Making DRR a priority: The city has very high score in institutional resilience. It must continue being innovative to keep its impressive performance. In 2009, the mayor of Mandaluyong, who was the president of the Union of Local Authorities of the Philippines (ULAP) and the League of Cities of the Philippines (LCP), was one of those pushing for the swift passage of the Disaster Risk Reduction and Management (DRRM) Bill. The mayor said he was particularly in favor of the institutionalization of DRRM at the local government level and the increased participation of NGOs in DRRM. Instead of putting money in the calamity funds, which are released when a disaster strikes, the DRRM bill will ensure that government resources will be invested in building the resiliency of communities in preparing for and coping with disasters.

Improving risk information and early warning: As some parts of the city get inundated by the Pasig River during heavy rains, constant monitoring of the river height during the rainy season is necessary to provide early warning to flood-prone residents. Also, statistical information on disaster risks, impacts, and losses must be compiled and disseminated. Sufficient funding will facilitate these tasks.

Building a culture of safety and resilience: Having the highest CDRI in Metro Manila, Mandaluyong can share good practices with other cities, as a guide to other cities as to what works and what does not work. Learning from these experiences can help city executives avoid the pitfalls of poor

planning or lack of planning. This move will also strengthen networks and promote dialogue and cooperation among disaster experts, planners, and stakeholders from different cities.

Reducing the risks in key sectors: In a disaster, progressive cities like Mandaluyong cannot afford to lose hospitals, schools, communication systems, transportation routes, evacuation centers, and government services buildings. The impact of a disaster can be reduced by ensuring prompt resumption of essentials services, such as power, sanitation, water, and access to basic government services.

Strengthening preparedness for response: The city should help households prepare for disasters in terms of logistics, materials, and management. Voluntary evacuation of residents living near rivers and creeks should be made one of the indicators of preparedness. Regular preparedness exercises, including evacuation drills, are the key to ensuring rapid and effective disaster response.

As the ''Tiger City of the Philippines,'' Mandaluyong should continue to strive being a model city in terms of urban risk reduction and disaster resilience. Other LGUs in the Philippines and in other countries can learn from Mandaluyong's example. It should therefore collate its best practices and disseminate these to other cities by posting useful information, experiences, and activities done by the city on its Web site and in its publications.

Malabon City Analysis

Malabon has the lowest GDP per capita among the cities of Metro Manila. The city is tagged as the local Venice, due to year-long floods and gradual sinking. Because the city is dissected by a river and a great part of it is below the sea level, some barangays are often flooded during high tides and rainy seasons. Clearing of structures, dredging the river, and cleaning all the esteros (canals) and waterways that drain into the river may be done to reduce the frequency and degree of flooding.

Physical: Among the cities of Metro Manila, Malabon has the lowest physical resilience. It has a high score in electricity but low score in accessibility of roads. The city scored low in the percentage of its land used as transportation network and percentage of city accessible by paved roads (asphalt or concrete roads).

Social: Malabon has a low score in population. The population under 14 years of age is high. The city's population density in 2007 was the fifth highest in Metro Manila at 23,076 per sq km. Among the LGUs of the

National Capital Region, Malabon has the lowest social resilience. Around one-third of the population of Malabon in 2002 lived in depressed settlements.

Economic: Malabon has the second lowest economic resilience in Metro Manila. The percentage of youth unemployed in the formal sector is high due to lack of education, special skills, or experience. These include the out-of-school youth and fresh graduates who have difficulty finding a job. The percentage of the city's household properties under any sort of insurance scheme is low. Without adequate protection, Malabon's urban poor will be exposed to a high degree of risk from floods and typhoons.

Institutional: In Malabon, as in many parts of Metro Manila, awareness raising needs to be intensified as many urban residents are not yet aware of the impacts of climate change. There is a need in the local government for increased political commitment to support and encourage DRR and CCA. City officials need to improve their coordination and collaboration with national government agencies, the academe, the private sector, and LGUs. The city should strengthen the capacities and competencies of its emergency personnel through training and capacity-building programs.

Natural: Among the cities of Metro Manila, Malabon has the lowest natural resilience. The frequency of floods and typhoons is high. The urban water quality in rivers is low. The intensity of land use is high. The total urban green space is minimal. There are settlements located on hazard-prone areas, further driving up the climate disaster vulnerability of Malabon. Flooding is worsened by local urban processes and activities that cause river flow obstruction and pollution. Many households reside on or near the riverbanks. Whether in its normal or flooded state, the river is a hazard to these communities. During continuous heavy downpours or typhoons, the river level rises so much that informal settlers have to vacate their homes and stay in evacuation centers until the floodwaters recede.

The following paragraphs discuss the five HFA priorities and what Malabon needs to accomplish under each priority based on the CDRI analysis results. These policy points and recommendations are suggested to provide encouragement to the city government's engagement in specific institution and capacity building.

Making DRR a priority: Strong commitment by the city government is needed to save lives and livelihoods threatened by natural disasters. And community participation is required so that local needs are met. The city should work on institutional collaboration and mainstreaming DRR. Efforts should be monitored so that there will be a basis on how future performance can be improved.

Improving risk information and early warning: A flood early warning system for local communities will not only save lives but also substantially reduce damage costs. The city should initiate city-wide risk assessments to provide a more complete and regularly updated picture of the city's risk and allow decision makers to better set priorities for action. The city may invite external experts and practitioners involved in hazard and vulnerability assessments to help in documenting and mapping capacities and vulnerabilities. Risks assessments identify both hazards to which residents are exposed and the city vulnerabilities. Risk assessments should consider the effects of urbanization (demographic changes), land-use change, environmental degradation, and climate change.

Building a culture of safety and resilience: Community-based training on emergency response should be provided to residents, especially to those living in flood-prone areas. Malabon should work on increased public awareness and education to enhance DRR. The city government should be proactive in engaging the citizens. It is advisable to actively participate in the month-long celebration of National Disaster Consciousness Month in July.

Reducing the risks in key sectors: Informal settlements along the riverbanks added to the pressures of pollution and flooding. Malabon's local authority and people should focus on how the physical restoration of the riverbanks and solid waste cleanup can contribute to flood disaster mitigation and prevention of waterborne diseases.

Strengthening preparedness for response: Even though the river has caused destructive flooding events over the years, the riverbanks are still considered as potential settlement sites by those who could not afford to buy land or property in safer parts of the city. Malabon's poor will have a difficult time dealing with the increased frequency and intensity of typhoons and floods. Participatory approaches can capitalize on indigenous coping mechanisms, which are sensitive to gender, cultural, and other context-specific issues that can empower residents to take locally based actions. Malabon should increase the number of its emergency workers and also increase and improve training programs.

Because of its geographical location, Malabon is always at risk to typhoons and flooding. The city should strive to increase its residents' awareness of the threats and impacts of disasters and enhance their participation in community activities where they can get information on DRR and climate change adaptation. City officials should address the city's very low economic resilience. A large percentage of the city's population is below the poverty line, severely affecting their coping capacity.

CONCLUSION

The need for disaster resilience strategy not just for Metro Manila but also for other large city clusters has been underscored by a series of hydrometeorological disasters in 2009, most notably by the back-to-back tandem of Typhoon Ketsana *(Ondoy)* and Typhoon Parma *(Pepeng)*. There was widespread flooding in most of the 17 cities of Metro Manila. Major roads were rendered impassable by severe flooding and stranded vehicles. The disaster demonstrated that because of the increasing interconnectedness of cities in a city cluster, massive flooding in one city affects surrounding cities in what can be considered the cascade effect of the disaster. The movement of passengers, goods, and services between cities became restricted, severely affecting the economy. This is especially true if the badly affected city is a nodal city or highly connected city in the city cluster. The challenge then is for the national government and most especially the local governments in the city cluster to develop effective policies, programs, and strategies that will help them manage disaster preparedness, disaster response, and disaster recovery to ensure safety and sustainable development. Cities play an important role in tackling DRR and climate change adaptation by thinking globally and acting locally. The local leaders are in a position to deliver results. If properly empowered and equipped, the city leaders can take the required customized actions within cities and in collaboration with other cities that can lead to substantial reduction of disaster losses, in lives as well as assets of communities. It is hoped that this research will provide a basis for enlightened discussion on the climate and disaster resilience of city clusters like Metro Manila, contribute to a better understanding of the issues, raise the level of policy debate, and more importantly, encourage everyone to assume responsibility for climate change adaptation and disaster preparedness. Only by doing this can we achieve safer and more sustainable urban agglomerates.

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OFFICIAL WEB SITES OF THE CITIES OF METRO MANILA

Caloocan City – http://www.caloocancity.gov.ph/
Las Piñas City – http://www.laspinascity.gov.ph/
Makati City – http://www.makati.gov.ph/

Malabon City – http://www.malabon.gov.ph/
Mandaluyong City – http://www.mandaluyong.gov.ph/
Manila City – http://www.manila.gov.ph/
Marikina City – http://www.marikina.gov.ph/
Muntinlupa City – http://www.muntinlupacity.gov.ph/
Navotas City – http://www.navotas.gov.ph/
Parañaque City – http://www.paranaque.gov.ph/
Pasay City – http://www.pasay.gov.ph/
Pasig City – http://www.pasigcity.gov.ph/
Pateros Municipality – http://www.pateros.gov.ph/
Quezon City – http://www.quezoncity.gov.ph/
San Juan City – http://www.sanjuancity.com.ph/
Taguig City – http://www.taguig.gov.ph/
Valenzuela City – http://www.valenzuela.gov.ph/

CHAPTER 6

CLIMATE AND DISASTER RESILIENCE MAPPING AT MICROLEVEL OF CITIES

Gulsan Ara Parvin, Jonas Joerin, Sunil Parashar and Rajib Shaw

INTRODUCTION

Building a resilient city requires detail and careful assessment of its current level of vulnerabilities and resilience. During such assessment and initiatives it should remember that there are large differences in risk and vulnerability within urban areas (Satterthwaite, Dodman, & Bicknell, 2009). It is natural to consider that the vulnerabilities and eventually the resilience level would not be same for all parts of a city, especially one that is relatively larger. A city, especially a large one, covers a substantial and often physiographically heterogeneous area with different exposures and susceptibility to hazards. Furthermore, a city's population and the conditions under which it lives are diverse. Therefore, some parts and peoples of a city may be more vulnerable than others (Klein, Nicholls, & Thomalla, 2004). In fact, cities form different microclimates within them because of the variations of land use, settlement patterns, functions, densities, and characteristics of the residential areas and their communities. All of these diversities contribute to disaster risk; in turn, these affect human development and the resilience of different parts of the city International Strategy for Disaster Reduction (ISDR).

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Recognizing the diversity within a city and its impact on vulnerabilities and resilience is a leading requirement in assessing the strength, weakness, opportunities, and threats of a city's microzones. For well governed urban center it is necessary to know the location specific and place specific needs through strong local information (Satterthwaite et al., 2009). But there are a number of studies and initiatives addressing different aspects of city's resilience and climate, disaster vulnerabilities considered the whole city as a single unit; while, neglected the issue of microlevel diversities and its implication to resilience. However, the Hyogo Framework for Action has emphasized the importance and specificity of local risk pattern and trends (ISDR, 2007) before any attempt is made to reduce disaster risks.

Recognizing the research gap and considering the importance of microlevel assessment of a city's resilience, this chapter attempts to depict the microlevel variations of climate-disaster resilience of cities through climate-disaster resilience mapping (CDRM) with climate-disaster resilience index (CDRI) methodology, which is discussed in Joerin and Shaw. With empirical studies of three South Asian cities – Chennai, Delhi, and Dhaka – this study intends to measure the resilience level of different parts (zones or districts) of cities from different socioeconomic, physical, institutional, and natural perspectives. It also identifies various issues that local authorities prioritize to enhance their resilience. This chapter also points out the challenges and implication of such kind of microlevel resilience assessment and formulation of CDRM. Finally, this chapter extends an opportunity to compare and contrast common issues.

CDRM AT THE MICROLEVEL OF CITIES: APPROACHES

Three cities from South Asia – Chennai and Delhi from India and Dhaka from Bangladesh – have been selected. All three cities are very important from the climate-disaster resilience perspective. Each city has a large population with a high growth rate and density. All three cities are focal points from both economic and administrative perspectives. In the context of exposure, risk level, vulnerabilities, problems, and potentialities each city has a heterogeneous composition. Therefore, microlevel climate-disaster resilience would be very crucial and effective for these cities.

CDRM graphically presents information for an area's climate-disaster resilience. This resilience is measured by the climate-disaster resilience index. The CDRI methodology is described in detail in the earlier chapters

(Joerin and Shaw, Chapter 3). Altogether, 125 parameters were used under five resilience dimensions. During selection of the cities for this study, the scope has been delimited within South Asia only. Besides the answer of 125 questions, there is provision to assign weight (from 1 to 5, or least to highest) to the parameters under each dimension according to their importance in case of climate-disaster resilience. Similarly, variables under each parameter were also assigned weight according to their importance. Because the aim of this study is to formulate CDRM at the microlevel of cities, the research unit is the microlevel administrative and functional unit of each city. The microlevel units of each of the selected cities are 10 zones of Chennai City Corporation, nine districts of Delhi City Corporation, and 10 zones of Dhaka City Corporation (DCC). Data has been collected from each microlevel unit of each city. For data collection, the researchers directly approached the officials (generally, higher-level relevant officials) who worked in each city's microlevel administrative and functional units. Through direct interview of relevant officials (sometimes individual officials and sometimes group of officials in a miniworkshop), answers to 125 questions were collected and weighted parameters and variables were assigned. After having all data, analysis and formulation of CDRM has been done using Excel software.

CITY CHARACTERISTICS

Chennai

Formerly known as Madras, the city of Chennai is located along the Bay of Bengal in the northern part of Tamil Nadu state (13°5′2″N latitude, 80°16′12″E longitude). Madras was founded in 1639 by British businessmen belonging to the East India Company. Followed by the establishment of Fort St. George in the same year, it became a seat of power along the Coromandel Coast (Muthiah, 2008) located at the Bay of Bengal. Over the next decades and centuries, Madras experienced rapid urban growth that was particularly triggered after the development of the first piers along the shoreline of the Bay of Bengal in 1861 to establish a port (Muthiah, 2008). The port expanded in succeeding years and contributed to Madras's growth in population and economy (Muthiah, 2008). In 1901, the city area stretched over an area of 70 km^2 and had approximately 540,000 inhabitants. During the following decades, population growth rates stood at 5 to 6 percent annually. In 1941, Madras became a provincial metropolis and an administrative and commercial center (Chennai Master Plan, 2008).

The population growth and city expansion continued in the following years and passed the 1 million population mark in 1943. After India gained independence in 1947 and became a republic in 1950, economic growth increased sharply until 1971. The consequences of this rapid growth became visible as slums grew along the canals and rivers and water-supply and drainage systems deteriorated in their quality. Chennai's municipal population was 4.34 million in 2001, with an average population density of 26,769 per km^2 (Chennai Master Plan, 2008). The current size of the city is 176 km^2, but it is planned to be increased to as much as 426 km^2 by 2011 because of accepted expansion plans that would incorporate additional villages and towns located just behind the current borders (Fig. 1).

The Corporation of Chennai consists of a central headquarters where citywide decisions are taken and subsequently devolved to zones to be implemented. As a result, the city is divided into 155 wards, each represented by an elected councilor. These wards are again grouped into 10 zones. Each zone is headed by a zone officer who is elected through a zonal committee constituted by the councilors of all the wards that belong to a particular zone. The zones have the primary administrative responsibility of carrying out urban services at a lower scale than if the duties were to be carried by a single body. Therefore, the zones have no legislative power. The tasks of the zones

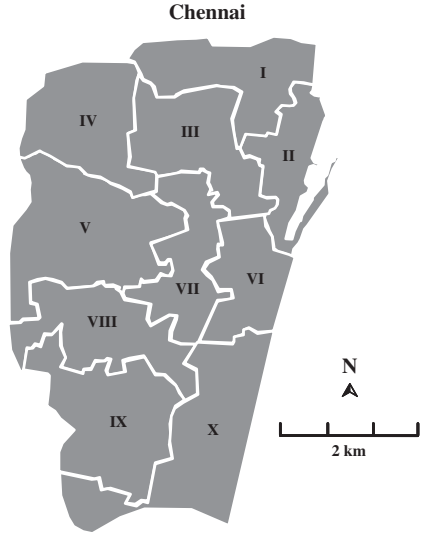

Fig. 1. Map of Chennai City Corporation Showing 10 Zones.

are, however, to collect taxes and provide urban services such as solid-waste management and approving planning proposals. While Chennai is growing rapidly, particularly along the urban fringe, the city has to deal not only with the increasing number of people in terms of providing basic urban services (electricity, water, and solid-waste management) but also in maintaining a positive life quality with regard to a fragile environment that is challenged by deteriorating quality of the air, soil, and water bodies.

The consequences of urban migration has become a compounding problem in Chennai as slums began to develop in the 1950s. As of 2001, 18.9 percent of the total population was urban poor predominantly living in hazard-prone areas such as in the vicinity of canals and water bodies (Chennai Master Plan, 2008). However, urbanization is taking place especially in the zones located along the urban fringe (2.54% population growth per annum) and do not affect the city's inner parts (0.90% population growth p.a.). It is expected that Chennai will become a megacity by 2025, surpassing the 10 million mark (UNHABITAT, 2008).

While the rising population challenges Chennai's physical infrastructure, the city is likely to experience stronger and more intense natural hazards in the future (IPCC, 2007) such as intense rainfall during the postmonsoon period between October and December and triggered before or after striking cyclones (Revi, 2008). However, so far there has been no observable increase in climate-related hazards. Nevertheless, the low-lying exposure of the city, which is just a few meters above sea level, may likely increase the risk of flooding (Revi, 2008). Although many areas, particularly along the urban fringe, lay just above sea level, groundwater levels may be visible at the surface when water cannot drain off for days after a heavy rainfall. To summarize, key disaster risks consist of the consequences associated with urbanization, flooding from intense postmonsoon rainfalls, and indirect impacts of sea-level rise.

Delhi

Delhi is located on the Indo-Gangetic plain south of the Himalaya Range. On the eastern side are the Aravali Hills, and adjacent are Haryana and Punjab states. Delhi is situated on the right bank of the Yamuna River. The city has an area of 1,483 km^2, with a population of more than 14 million. It is among world's largest cities and is increasing in population. The population size was 11.7 million in 2000 and is expected to reach 16.808 million in 2015.

Delhi became a centrally administered state soon after 1947 when India got its independence. It was offered the status of national capital territory in

the 1990s. The current administrative structure comprises a three-tier administration of legislative council, municipal corporation, and lieutenant governor (Fig. 2).

As of July 2007, Delhi comprised nine districts, 27 tehsils (administrative units that generally serve as headquarters), 59 census towns, and 165 villages and three statutory towns: the Municipal Corporation of Delhi (MCD), the New Delhi Municipal Committee (NDMC), and the Delhi Cantonment Board (DCB). The civic administration Delhi is governed by three municipal bodies: the MCD, the NDMC, and DCB. Among them, MCD is one of the largest municipal corporations in the world, providing civic amenities to an estimated 13.78 million people. The capital city of India falls under the administration of the NDMC. Urban planning and development is look after by the Delhi Development Authority and also by the National Capital Regional Planning Board (Ministry of Urban Development). All major activities related to disaster issues such as prevention, preparedness, mitigation, response, and relief are handled with structural approach. The Delhi Disaster Management Authority (DDMA) is the principal body that handles disaster-related issues in Delhi. At the district level, District Disaster Management authority and crisis-management groups are formed and

Fig. 2. Map of Delhi City Corporation Showing Nine Districts.

headed by the deputy commissioner of each particular district. The authority looks after the disaster-management activities and reviews and updates plans every year. The crisis-management group makes decisions during emergencies. Its other role includes organizing mock drills and meetings at the district level.

Since independence, the city has grown in a haphazard way. In 1975, Delhi was ranked 23rd among the world's largest cities with large populations, and in 2000 it became 13th (Planning Department, 2009). There has been a rapid increase in the slum, squatter, and migrant populations in Delhi. The rapid pace of urbanization leads to massive growth of slums followed by misery, poverty, unemployment, exploitation, inequalities, and degradation in quality of life. The total population is expected to reach 19 million in 2011. More than 50 percent of the total population lives in slum areas with inadequate public services. The settlements located on hazard-prone areas such as near the riverbed and hazardous industries have increased in the last two decades. Most of the housing in Delhi is constructed utilizing local construction practices. Less than 5 percent of the buildings in Delhi have followed building codes. The traditional buildings are more vulnerable to natural hazards.

The city experiences severe water scarcity. In 2005, the water demand–supply gap was 236 million gallons per day (MGD). It is expected to rise to 247 MGD in 2011 and 564 MGD by 2021. Because of the increased consumption of ground water, the water level has also gone down over the last few decades. The collection and treatment of solid waste is a major problem of the MCD. The city produces 8,000 tons of solid waste every day but only three dumping sites out of 23 are functioning, making the city vulnerable to health-related hazards. The city also faces the problem of flooding caused by an inefficient drainage and sewerage system. Wastewater often flows into the Yamuna River without undergoing treatment. Power-supply interruptions are common in the city.

The city environment is degraded from air pollution, water pollution, and improper solid-waste disposal. In the last 50 years, extensive urbanization has contributed to the depletion of the city's land and water resources. The city groundwater level is decreasing by 2 m every year (Misra, Chadah, & Pathania, 2010). The concentration of pollutants such as waste products, pesticides, and heavy metals has increased in water bodies and soil. The city is vulnerable to natural and human-made disasters. Flood, earthquake, fire, epidemic diseases, and terrorist attacks have become common in recent decade. Increasingly, the city has become especially vulnerable to climate-related hazards such as floods caused by unpredictable rainfall patterns. For

instances, the city has experienced six floods: in 1924, 1947, 1976, 1978, 1988, and 1995 (DDMA, 2009). The threat from the flood has increased since 1978 (DDMA, 2009). To face this recurrent natural phenomenon, recently, a climate action plan agenda was put forward by the city government.

Dhaka

Dhaka City is located at the center of Bangladesh. It is placed between 24°40′N to 24°54′N latitudes and 90°20′E to 90°30′E longitudes. Different sources have different estimations regarding the area, population, and population density of DCC. The DCC Web site shows the area of DCC is 360 km^2, which accommodates 8 million people (estimated in 2004) with a density of 22,222 persons per km^2. The Bangladesh Bureau of Statistics (BBS, 2001) estimated the area of DCC as 276 km^2 with a population of 5.3 million and the population density to be 19, 286 per km^2. The population density of DCC is said to be more than double the megacity average (Fig. 3).

Though Dhaka has a very long history dating from the 7th century a.d., the history before the 16th century is obscure (UNEP, DoE, & BCAS, 2005). During the regime of Mughal Emperor Zhangir, Dhaka was formed as the provincial capital and renamed as Zahangirnagor in 1608 a.d. In 1864, Dhaka was established as a municipality. After Bangladesh's independence in 1971, Dhaka was declared as the capital. In 1978, the Dhaka municipality was awarded the status of corporation; finally, in 1990 Dhaka Municipal Corporation was renamed as DDC. At that time, DCC was divided into 10 zones to decentralize its administrative and functional duties (DCC Web site, 2010). The DCC's executive power is vested in and exercised by an elected mayor, who is assisted by the chief executive officer, who in turn is assisted by the secretary, the heads of departments, and zonal executive officers (ZEOs). For 10 DCC zones, there are 10 ZEOs and about 12,200 employees carrying out different duties to fulfill the civic needs of the city dwellers. Rather than formulate and implement the city's master plan and development plan, DCC primarily performs maintenance and civic activities. Among a long list of DCC's functions worth mentioning are slum and community development plans; delivery of primary health-care facilities; solid-waste management and conservancy; taxation; maintenance of roads; provision of street lighting, footpaths, parks, and playgrounds; control of markets and food; provision of trade licenses; and birth and death registration.

Among the different challenges of rapid urbanization, environmental degradation and increase of disaster risks are the most important. Dhaka is considered to be one of the fastest-growing cities in the world in recent

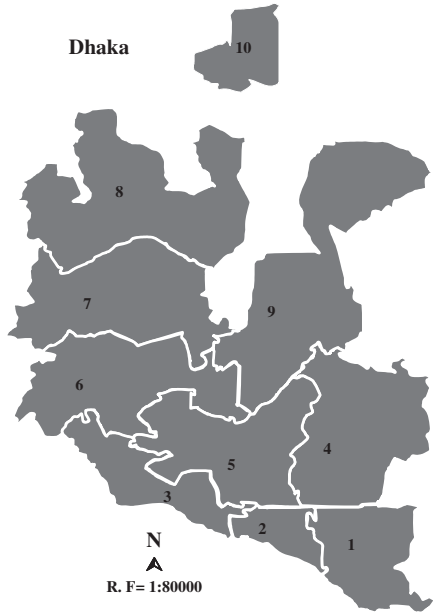

Fig. 3. Map of Dhaka City Corporation Showing 10 Zones.

decades (Roy, 2009). Over the last three decades, the average annual growth rate of Dhaka was above 6 percent (BBS, 2001). From the 16th century to 2001, the area of Dhaka city metropolitan area extended from 2 km^2 (approximately) to 1,530 km^2, and population increased from 30,000 to 10.7 million (Hossain, 2008,). Besides the natural growth of population, large-scale rural to urban migration is one of the principal factors for Dhaka's rapid urban growth. The majority of the migrants of Dhaka are slum dwellers and squatters: an estimated more than 3 million people, or 40 percent of the city's population. Cities Alliance estimated that every year about 500,000 people migrate to Dhaka from coastal and rural areas. It is claimed that Bangladesh is one of the rare countries where natural hazards are the main cause of migration (Piguet, 2008, cited in Michael & Svarin, 2009).

Along with the problem of rapid urban growth and increasing numbers of slum dwellers and squatters, Dhaka faces a long list of environmental issues. The city's air-pollution problem is critical. In Dhaka, especially in the commercial areas, suspended particulate matter is 10 times higher than the standard of the World Health Organization. Unplanned industrial

development along the riversides and unhygienic latrines of slum dwellers are the primary causes of Dhaka's severe water pollution. Only 44 percent of solid waste is disposed to the landfill sites, which are open and without any gas-collection system. Noise pollution has exceeded the tolerable limit in most parts of Dhaka (UNEP et al., 2005). In addition, Dhaka's transportation system is unwieldy and chaotic. In whole parts of the city, the transport system is extremely hazardous, expensive, and time consuming (Islam, 2009).

In addition to environmental problems and challenges, recurrent natural disasters, especially annual flooding, is one of Dhaka's most troublesome issues. The main cause of floods in Dhaka is the rise in water levels of the rivers bordering the city during monsoon season (Faisal, Kabir, & Nishat, 2003; Faisal et al., 2003). Dhaka is surrounded by distributaries of two main rivers, the Brahmaputra and Meghna. All sides of Dhaka are bounded by rivers and cannels. In addition to the rise of river water, internal drainage congestion and poorly coordinated flow regulation structures make the flood situation worse. With rainfall intensity increasing, extreme events such as floods, drainage congestion, and water logging becoming a regular occurrence in the rainy season. The severity of such occurrence increases each year because of climatic change and changes in human activities. Scholars claim that Dhaka also will be affected by heat stress from climate change. Dhaka may face a heat-island problem because city temperatures are a few degrees higher than surrounding areas. Vehicle emissions, industrial activities, increases in built-up areas, the loss of open spaces, and the increasing use of air conditioning are contributing to heat generation in Dhaka that will continue into the future (UNEP et al., 2005; Alam & Rabbani, 2009).

Key CDRM results and commonalities

Overall CDRM

From an overall perspective, the CDRI scores among the three cities at different microzones or districts range from 2.4 to 4.1. The highest score of 5 denotes a medium to high level of resilience. Dhaka has the lowest CDRI scores, Delhi the highest. It is interesting to notice that 3.1, which is the highest score for Dhaka, is the lowest score for Delhi. In fact, Dhaka has the lowest scores all five CDRI dimensions: physical, social, economic, institutional, and natural. Chennai scores in the middle, and Delhi scores the highest. Fig. 4 shows the overall zonal or district CDRI values.

In Chennai, seven of 10 zones scored from 3 to 3.7 (out of 5), and the remaining three zones scored from 2.6 to 2.9. Overall CDRI scores tend to be lower for zones I, II, III, and VI. All of these zones are neighbors and located in Chennai's northeastern section. Poor scores in socioeconomic and natural dimensions have contributed to their low level of overall CDRI scores. Newer and economically faster-growing zones (zones IV, VII, and IX) in the south and southwest tend to have higher overall resilience scores. Relatively higher scores in economic, institutional, and, to some extent, social dimensions are responsible for the higher overall CDRI score.

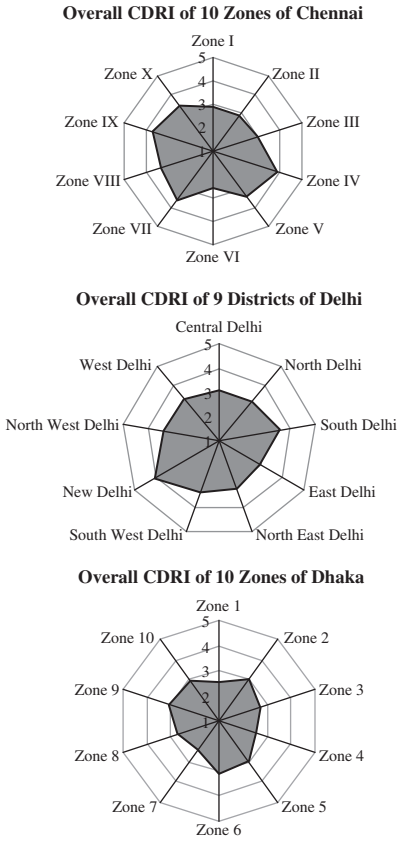

Fig. 4. Climate-Disaster Resilience Mapping of Three Cities from Overall Perspective (CDRI Scores).

The overall resilience of all nine districts of Delhi is between medium to good (from 3.1 to 4.1 out of 5). New Delhi is the most resilient district among all nine districts, and East Delhi is the lowest resilient district. The overall resilience is low for districts with high population densities and high for districts with low population densities. District with high densities show low physical, social, economic, and natural resilience and vice versa.

In the case of Dhaka, the overall CDRI scores range from 2.4 to 3.1. Notice that the planned residential areas (zones 6, 9, and 10) have relatively higher-level scores in the CDRI, whereas older parts of the city (except zone 2) and densely populated low-income sections in the fringe areas have lower levels of resilience scores than other areas.

CDRM in five different dimensions

Chennai

Looking at the overall CDRI of Chennai (Fig. 4), the northern parts of Chennai (zones I–III) tend to perform weaker than the southern, central, and western parts of the city (Fig. 1), especially in economic and natural resilience levels. The flourishing port (zone II) is located in the north, but recent development activities have taken place in the southern and western parts of the city, where large information-technology centers and car companies are being established, which are ultimately reflected in those areas' higher economic CDRI scores (Fig. 5). CDRI scores in physical dimensions vary from 3.2 to 3.9, which means a good level of climate-disaster resilience. However, comparative results among the zones imply that older zones (II, III, VI, VII) have lower physical CDRI scores than newer zones and underscore that urbanization may not necessarily challenge a city's physical infrastructure. It may be the opposite: Older zones are given less attention to uphold well-functioning urban services (e.g., water, sanitation, and solid-waste disposal). Note here that zones I and V have the highest scores in physical CDRI. In these two zones, most people have access to safe drinking water and hygiene sanitation; the most remarkable point is that more than half of the buildings in these zones are constructed following building codes.

Social CDRI scores ranges from 2.5 to 4, showing that Chennai's northern zones (zones I, II, and VI) have somewhat lower social resilience compared to the more prosperous southern and northern parts (zones VIII and IX). In these zones, population density is very high and the literacy rate is lower than the Indian average (except zone VI). Unlike the other zones, in I and II about one-fourth of the people suffer from vector-borne and

waterborne diseases, respectively. Scores of economic CDRI vary widely, ranging from 2 to 4.6. Economic resilience scores imply that zones I–III especially have lower scores, unlike the southern part of Chennai, which tends to be more resilient, probably because many recently established projects have lifted the economic resilience of these areas. Institutional CDRI scores have low variation between the zones (between 3 and 4) and may highlight the administrative purpose of zones to function on behalf of the central corporation office and to perform the assigned duties. The natural dimension matches to a large extent the actual situation in which the northern parts of the city are less resilient than the southern or central parts. This is because heavy industries such as the port, solid-waste disposal plant, coal-fired power plants, and so on are located in those areas. Not surprisingly, zone 7 has the highest natural resilience because mostly commercial and residential land use dominate this area.

Delhi

The New Delhi district has obtained the highest scores among all nine districts on the CDRI's physical, social, economic, and natural dimensions. From the physical perspective, electricity, water, and road accessibility are the three most important factors that make New Delhi the most resilient district. From a social perspective, population density and population growth help raise its score to high. New Delhi's income, employment, and household assets are the economic factors behind the higher score in economic dimensions. Three factors are most responsible for New Delhi's high score on the natural dimension: intensity and severity of climate-related hazards, frequency, and land use in natural terms. The district is not vulnerable to flood and is less vulnerable to heat waves and water scarcity, an average of once per year. The land use in natural terms is good. The district land has no settlements located on hazardous ground. The district has well maintained gardens, trees, and so on. This district has a separate municipal body that manages civic services and the natural environment. There are fewer interruptions in water and electricity than in other districts, and road conditions are also better.

CDRI assessment from physical and natural dimensions shows that the East Delhi district is the least resilience (Fig. 5). The main reasons for very low resilience are poor sanitation and solid-waste disposal, low levels of housing and land use, and water. The main factors contributing to low resilience are intensity and severity of climate-related hazards, ecosystem services, and land use in natural terms. The district is highly vulnerable to flooding because of its location near the Yamuna River. In the recent past, the district flooded in

1980 and 2008. Land use in natural terms is very poor. The land-use pattern shows that the district area is mostly occupied with highly dense populated area. No green space is left. Moreover, a large population resides on hazardous ground. Among all nine districts, the northeast has the lowest CDRI score. The district's population density is the highest: 29,468 persons per km^2 in 2001. The annual population growth rate is also highest among all districts, more than 6 percent in 2001 (Planning Department, 2009).

Central Delhi scored the lowest on the CDRI's economic dimension. The main factors responsible for low resilience are income, employment, and finance and saving. Most of the working population in this district is engaged in household industries. The working population is 35 percent of the total population. The dependency ratio is 1.88, and in certain areas the dependency ratio is 2. A large household often has only one earner. According to the 2001 census, as much as 70 percent of the central Delhi population lives in slums.

The institutional setup is common for the nine districts. They follow common guidelines laid down by the National Disaster management Authority and the DDMA. The resilience level of all districts is between medium and good. However, the mainstreaming of disaster risk reduction and climate-change adaptation is not visible in all nine districts. The development plan has poorly incorporated disaster risk reduction in master plan 2021.

Dhaka

In Dhaka, zones 9 and 10 are planned residential areas for higher-income groups, and they have relatively better conditions in almost all physical dimension variables and have achieved higher scores in the CDRI. Being a diplomatic area, zone 9 does not face interruptions in electricity and water supply, which are common in other areas. Similarly, building codes tend to be followed more and house ownership is higher in these zones. Interruption in electricity and water supply is severe in zones 4 and 8, and most of the buildings are constructed without building code.

In the social dimension, zones 1, 2, and 3, the most densely populated old parts of Dhaka, have relatively higher scores. Among different factors, social capital – such as community participation, acceptance of community leadership, and ethnic interlinks – plays a prevailing role in the higher score in CDRI's social dimension. Zone 4, which is Dhaka's principal central business district, and zone 7, which is a mixed residential and commercial

area, score poorly on the social CDRI. Here also social capital, community preparedness, and health status contribute to the zones' low scores. Because of flooding (in zone 4) and water logging (in zone 7), approximately one-fourth of the population of these two zones suffers from waterborne disease. CDRI scores in economic dimension vary from 2.1 to 3.4. Out of 10 zones, only two obtained scores above 3; the other eight zones have scores of 2.1 to 3. In the economic dimension, zones 9 and 10 have the highest scores (3.11 and 3.41 respectively). Being the residential areas of higher-income groups, the income, employment, and household assets of these zones are higher. In both of these zones, approximately 40 percent of the households have motorized vehicles, a much lower figure in other zones. Furthermore, in these two zones the slum population is very low, approximately 10 percent. Zones 1 and 3, which received the lowest economic dimension scores on the CDRI (2.1 and 2.4, respectively) are the most densely populated poor areas of Dhaka. Most of the slums are located in these zones, and more than 40 percent of the population lives below the poverty line. Income, employment, and household assets are the prime factors for their low CDRI economic scores.

For the institutional dimensions of the CDRI, zones 6 and 9 are better off than the other zones. In contrast, zones 7 and 10 score the lowest of the 10 zones. In fact, the mainstreaming of disaster risk reduction and climate change and the overall management of disaster are handled centrally by the DCC. In spite of this, in the aspect of effectiveness of zone's crisis-management framework, knowledge dissemination, institutional collaboration and good governance some zones evaluate them as medium to good and some zones (such as 7 and 10) as poor. This assessment has ultimately determined the CDRI score in institutional dimension. The CDRI scores for the natural dimension show that zones 1 and 3 are in poor condition. More than 50 percent areas of these two zones are very vulnerable to climate-related hazards. Being located on the banks of the Buriganga River, both zones face severe flooding almost every year. Moreover, high density, poor housing conditions, and limited green spaces have made these zones poor on the CDRI's natural dimension. In contrast, zones 2 and 6 are not vulnerable to flood, and more than 75 percent of the areas of these two zones are not vulnerable to climate-related hazards. Notice that zone 6, which is the location of national parliament and residential areas of parliament members, and zone 9, which is the diplomatic zone and where all embassies are located, have relatively higher scores in physical, economic, institutional, and natural dimensions and eventually have the highest scores in overall CDRI (Fig. 5).

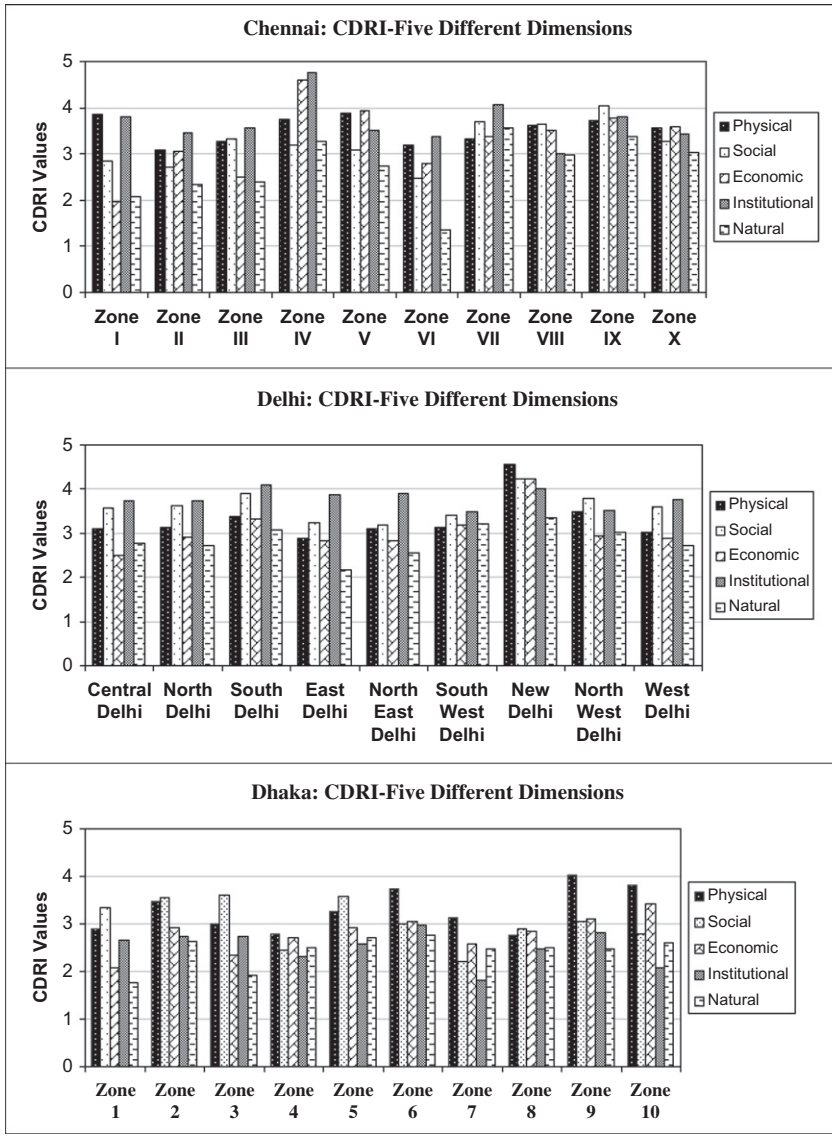

Fig. 5. Climate-Disaster Resilience Levels of Different Areas of Three Cities in Five Different Dimensions.

Important Sectors and Issues to Enhance Climate-Disaster Resilience of Cities

Each zone or district authority was asked to prioritize the sectors (parameters) and issues (variables) it considered as important in enhancing the climate-disaster resilience of its respective area. Parameters and variables were ranked by zonal officials using a five-point rating scale. For each city, important sectors and issues have been identified by making an average of the scores obtained by each parameter and variables in different zones or districts. After summarizing the prioritized sectors and development issues of each city, the following tables present the most important sectors and issues that enhance each city's climate-disaster resilience (Table 1).

Chennai shows that the highest and most important sectors (parameters) are government-led or -influenced aspects such as the provision of electricity, institutional collaboration, and the accessibility of roads, reflecting the fact that data was retrieved from local governmental authorities (zones). This also confirmed that crisis management is likely to perform well and is expected to

Table 1. Most Important Sectors (Parameters of CDRI) in Three Cities (According to the Perception of Zonal Officials).

Name of City	Most Important Parameters of CDRI	Average Score (Out of 5)
Chennai	1. Electricity	4.9
	2. Institutional collaboration	4
	3. Accessibility of roads	4
	4. Health	3.9
	5. Crisis management	3.9
Delhi	1. Water	4.2
	2. Income	4.2
	3. Employment	4.1
	4. Community preparedness	4.0
	5. Land use in natural terms	3.9
Dhaka	1. Ecosystem services	4.3
	2. Environmental policies	4.2
	3. Education and awareness	4
	4. Employment	3.7
	5. Accessibility of roads	3.6
	6. Community preparedness	3.6

provide the needed response in case of disaster. On the other hand, aspects of urbanization and its associated consequences such as the high use of natural resources and limited solid-waste management is reflected in lower CDRI scores, emphasizing that improvements in these areas are needed throughout the city.

In the case of Delhi, water supply, income and employment, community preparedness, and land use are the highest-priority sectors. All scored approximately 4 out of 5, which makes them crucial for climate-disaster resilience. Delhi's water-supply system does not provide even and equal distribution in all parts of the city and for all communities. Those who live in close proximity to the city's water tanks have a relatively better supply. Therefore, for a large part of the city, access to adequate water is a big concern, and the city authority has supported this by prioritizing access. Income and employment are also high priorities; if people have employment opportunity and adequate income, then they are less vulnerable and will be more resilient in being aware of potential disasters and better prepared to face them. Land use is another important sector, because Delhi's built-up area increased by 10 percent over the last decade, but not in a planned manner (Government of Delhi, 2006). Development issues (variables) are also reflected, especially in building code enforcement, which has been selected as the most important issue. City authorities also suggest that poverty, health facilities, community participation, and population burdens are other priority issues for Delhi's climate-disaster resilience (Table 2).

Because Dhaka is one of the fastest-growing cities in the world, its developed area is increasing and green spaces and environmental conditions are degrading rapidly. Therefore, most zonal officials emphasize the ecosystem and environmental policies. They also support that education, awareness, and community preparedness are crucial to enhancing the city's climate-disaster resilience because these aspects will increase the community's ability to be prepared for disaster. Employment and road facilities would be complementary factors to enhance any community's CDRI. With climate-disaster resilience as the prime concern, most zonal authorities consider the issues that are directly related to climate disaster when prioritizing development issues. As a result, they prioritize the incorporation of disaster risk reduction and climate change in the zone development plan, community participation, NGOs, the participation of CBOs, the annual budget for disaster management, and interconnectedness and prompt action during disasters.

Table 2. Most Important Development Issues (Variables of CDRI) in Three Cities (According to the Perception of Zonal Officials).

Name of City	Most Important Variables of CDRI	Average Score (Out of 5)
Chennai	1. Extent of implementation of environmental conservation policies	4.1
	2. Zone's electric supply authority ability to provide electricity	4
	3. Awareness or knowledge of population about the threat and impacts of disasters	4
	4. Extent of zone population's participation in community activities	4
	5. Percentage of youth unemployed in formal sector	4
	6. Effectiveness of emergency team during a disaster (leadership and competence)	3.9
	7. Floods	3.9
	8. Extent of zone's population provided shelter or emergency support for affected people after a disaster	3.8
	9. Percentage of zone's annual budget targeting disaster risk management	3.8
Delhi	1. Percentage of buildings constructed following building codes	4.8
	2. Percentage of district population living below poverty line	4.4
	3. Capacity of district's health facility to face emergencies and hazardous situations	4.2
	4. Percentage of district's population under 14 and over 64	4.1
	5. Extent of district's population participating in community activities	4
Dhaka	1. Incorporation of DRR and CCA measures in zones development plan	4.4
	2. Extent of zone's population participate in community activities	4.1
	3. Capacity of zone's health facility to face emergencies and hazardous situations	4
	4. Total % of zone's population living in proximity to polluted industries, dumping grounds, sea beach	4
	5. Percentage of zone annual budget targeting disaster risk management	4
	6. Existing emergency teams during disaster	4
	7. Extent of use of zone-level hazard maps in development activities	4
	8. Awareness or knowledge of population about the threat and impacts of disasters	3.9
	9. Extent of support from NGOs, CBOs, or religious organizations after a disaster	3.9
	10. Extent of support from NGOs, CBOs, or religious organizations after a disaster	3.9
	11. Interconnectedness (network) and collaboration with neighboring zones for emergency management during a disaster	3.9
	12. Promptness of zone body to disseminate emergency information during a disaster to communities	3.9

Interrelationship among CDRI Parameters

After priority assessment, an attempt was made to determine the interrelationships among different sectors (parameters) and development issues (variables). Table 3 shows different sectors and issues that have strong correlation (more than 0.79).

Different development sectors and issues that are assessed during CDRI assessment influence each other. Therefore, correlation analysis has been conducted to identify the sectors and issues that are correlated. This type of correlation analysis would help to formulate effective polities that address the development sectors to enhance climate-disaster resilience of cities.

For Chennai, interesting correlations are available for income with household assets, confirming the assumption that higher-income levels of people also lead to more household assets. Another high correlation coefficient between social capital and environmental policies may point out that better functioning and interlinked communities also have higher awareness to protect the environment and comply with environmental policies. Better education levels also correlate with community preparedness,

Table 3. Parameters with High Correlation Value.

Name of City	Correlated Parameters Having Correlation Values Around 0.8	Correlation Value
Chennai	Income and land use in natural terms	0.90
	Social capital and environmental policies	0.88
	Income and household assets	0.86
	Income and ecosystem services	0.83
	Household assets and ecosystem services	0.83
	Education and awareness and community preparedness	0.81
	Mainstreaming and knowledge dissemination	0.81
Delhi	Population vs. income	0.81
	Population vs. employment	0.81
	Health vs. environmental policy	0.79
	Social capital vs. effectiveness of crisis management	0.80
	Social capital vs. institutional collaboration	0.80
	Knowledge dissemination vs. ecosystem	0.84
Dhaka	Housing and land use vs. household assets	0.83
	Budget and subsidy vs. knowledge dissemination	0.85
	Income vs. land use in natural terms	0.82
	Household assets vs. ecosystem services	0.88
	Accessibility of road vs. land use in natural terms	0.79
	Housing and land use vs. income	0.79

which seems to make sense as a more knowledgeable community is likely to be better prepared for a climate-related disaster and may respond (resilience) more positively to such an incident compared to a less-educated community.

Delhi's CDRI results show that the population has a positive correlation with income and employment, mainly because of the increase in contribution of service sectors in Delhi's state domestic product. The share of service sector in the state domestic product increased from 71 percent in 1993–1994 to 78 percent in 2003–2004. The increased population was well absorbed in the service sector. The number of people living below the poverty line has also declined in the last few decades. Near half of Delhi population was living below the poverty line in 1973–1974; the number declined to 8 percent in 2001. This shows that, even with a rapid increase in population, the number of people below the poverty line has declined over the past 30 years. This shows positive correlation between population with employment and income. Environment policy and health show positive correlation with each other. Environment policies are sound measures for environmental issues such as air and water pollution. If these issues are not addressed properly, they affect human health. Therefore, an improved environmental policy has a positive impact on health.

The study shows a positive correlation among institutional collaboration with organizations and stakeholders and social capital. The social capital is mainly social networks. Therefore, social networking can play an important role in institutional collaboration with community-based organizations. There is also a positive correlation among social capital and an effective crisis-management framework. The social networking is very effective in alternative decision making during disasters, which also reflects the effectiveness of the crisis-management framework. Therefore, social capital can also improve the effectiveness of the crisis-management framework. On the other hand, this study shows positive relation among knowledge dissemination and management and ecosystem services. In fact, the knowledge dissemination deals with the awareness program for education. Therefore, the better the knowledge of disaster education the more people can help their communities in maintaining the ecosystem, where they live.

In the planned residential areas of Dhaka, people have higher incomes and good employment and eventually have better household assets. This has been supported by the high correlation values in the case of housing and land use versus household assets, housing and land use versus income, and income versus land use in natural terms. Another interesting correlation is between accessibility to roads and land use in natural terms. Areas that are

more vulnerable to climate-related hazards and that have fewer green spaces are also poor in different aspects of accessibility to roads (e.g., zones 1 and 3). It is also interesting to notice that the issue of household assets has a strong correlation with ecosystem services. In fact, the higher-income groups that have better household assets live in planned residential areas, which have relatively better ecosystem services.

Common Facts among Three Cities

The overall analysis of CDRI scores, priority selection, and the correlation between different sectors and issues imply a few common facts for the three cities. In the poor and densely populated areas, the relatively older parts of the cities have low overall CDRI scores. In contrast, the cities' newly developed areas, administrative zones, and planned areas have relatively higher scores in physical, economic, and natural dimensions and eventually in overall scores. During priority selection of the development sectors to enhance each city's climate-disaster resilience, each city has higher community participation. Annual budgets for disaster risk management and peoples' awareness of threats and disaster impacts have been prioritized in both Chennai and Dhaka. Both in the case of Chennai and Dhaka variables like income versus land use in natural terms and household assets versus ecosystem are correlated.

CHALLENGES AND POTENTIALS OF CDRM STUDY AT THE MICROLEVEL

The main objective of formulating the CDRM by using CDRI scores at the microlevel was to focus on one of the lowest institutional scales of decision making and to identify any variations within the zones or districts in each of the three cities. It is difficult to concentrate on the very local level because of the limited availability of data; however, it allows understanding the processes from a more perception-based view of respondents who are occupied in the particular areas and know best the vulnerable parts or resilient aspects of their zone or district. Therefore, adopting the CDRI at the microlevel is a viable approach to spur planning for safer and more resilient local areas.

Any study that addresses microlevel problems and issues requires knowledge and information at the grassroot level, which is often a challenge, especially when the microlevel community is located in a developing country.

For many researchers, developing country grassroot-level data is not available or is not reliable. Despite this, the approach of CDRM necessitates a wide range of data related to physical, social, economic, institutional, and natural dimensions of local areas (zone or districts within a city) of three cities of India and Bangladesh.

This study faced a number of different challenges during research at the microlevel. An important challenge for this kind of study is to have accurate answers for each question, which means detailed microlevel data. The length of the questionnaire and the long process of approaching the city governments sometimes posed serious obstacles. Nonavailability of data at the microlevel often posed a serious problem in all the cities. Some confusion seems to have arisen in the priority selection because each problem seems to have a higher priority for local city or subcity managers. Some of these obstacles were overcome through arranging workshops at the city and subcity levels, where different members of the city government participated in filling out questionnaires and making certain decisive judgments.

Microlevel analysis is always helpful to understanding the actual complexity of a city and its services. CDRM from overall perspectives and from five different dimensions can vividly depict the picture of the strength, weakness, opportunities, and threats of a local area. Therefore, during strategic planning or policy formulation process, it is easy to recognize the priority sectors and needs of a specific area. Eventually, this kind of strategic planning can be more effective for the locality. Not only the strategic planning or detail area action planning but also the budget-allocation process can be guided with the outcome of CDRM of a specific area. CDRM can facilitate area-specific, priority issue–specific, and risk- and vulnerability-specific budget allocation. With the use of the CDRM, the comparative position of a local community, zone, or district in five different dimensions can be examined. Results of this examination finally can be valuable inputs in the policy formulation processes of development organizations. Through CDRM, policy makers, city authorities, local-level development initiators and partners, and donors and funding agencies can be aware of the status of climate-disaster resilience of the microlevel local community. Finally, the CDRM process can also help in monitoring the progress of specific microlevel actions.

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CHAPTER 7

LINKING RESILIENCE PLANNING TO HYOGO FRAMEWORK FOR ACTION IN CITIES

Yuki Matsuoka and Rajib Shaw

INTRODUCTION

The international agenda on disaster risk reduction (DRR) advanced significantly in the last two decades. In the late 1980s, increasing losses in development gains from disasters prompted a global movement toward DRR. The United Nations declared the 1990s as the International Decade for Natural Disaster Reduction (IDNDR) to contribute to technical and scientific buy-in and to make DRR agenda imperative. The "Yokohama Strategy and Plan of Action" adopted at the first United Nations World Conference on Disaster Reduction (WCDR) in 1994 through the mid-review of IDNDR provided the first blueprint for disaster reduction policy guidance focusing on social and community orientation. At the end of the IDNDR in 1999, the United Nations General Assembly established International Strategy for Disaster Reduction (ISDR) as the successor mechanism of IDNDR within the United Nations to promote increased commitment to DRR and strong linkages to sustainable development.

Three weeks after the catastrophic event of the Indian Ocean tsunami, the second UN WCDR was held in January 2005 in Kobe City, Hyogo Prefecture, Japan. With stronger political commitment on DRR, the

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"Hyogo Framework for Action (HFA) 2005–2015: Building the Resilience of Nations and Communities to Disasters" (HFA) was adopted by 168 member states and endorsed unanimously by all UN member states in the General Assembly. International DRR agenda shifted from technical and scientific work among experts to political commitment backed by such experts. This shift and increased recognition of DRR led to the development of HFA as the comprehensive DRR policy guidance to all stakeholders.

The ISDR system's objective is to generate and support a *global DRR movement* and to build "a culture of prevention" in societies as part of sustainable development. In pursuit of this objective, the ISDR system coordinated by the United Nations International Strategy for Disaster Reduction (UNISDR) secretariat supports nations and communities to implement HFA, raises disaster reduction profile in organizational priorities and programs, and builds a stronger, more systematic, and more coherent international effort to support national disaster reduction efforts. ISDR system consists of governments, intergovernmental and nongovernmental organizations (NGOs), international financial institutions, scientific and technical bodies, and specialized networks as well as civil society and the private sector (Fig. 1), which play essential roles in supporting nations and communities in DRR. The UNISDR secretariat supports the ISDR system in HFA implementation.

The level of actions of the ISDR system includes global, regional, national, and thematic levels. Global Platform on Disaster Risk Reduction is the main global forum. It allows key actors to assess HFA implementation progress, enhance awareness of DRR, share experiences and learn from good practice, and identify remaining gaps to accelerate national and local implementation. Regional Platforms includes representatives from states, national platforms, NGOs, scientific and technical organizations, and regional intergovernmental organizations, UN offices, economic commissions, development banks, intergovernmental organizations, committees, associations, and networks. National Platform for Disaster Risk Reduction is a nationally owned and led forum or committee for advocacy, coordination, analysis, and advice on DRR. Ideally, National Platforms are comprised of various stakeholders to combine different expertise. Stakeholders include government, NGOs, academic and scientific institutions, professional associations, Red Cross/Red Crescent Societies, private sector, media, etc. Thematic Platforms build on existing specialized partnerships, networks, and other mechanisms on a specific thematic area of focus. A number of self-organized thematic platforms mainly composed of technical and scientific bodies have been established. They integrate global technical expertise, regional concerns, and national capacities within the thematic areas.

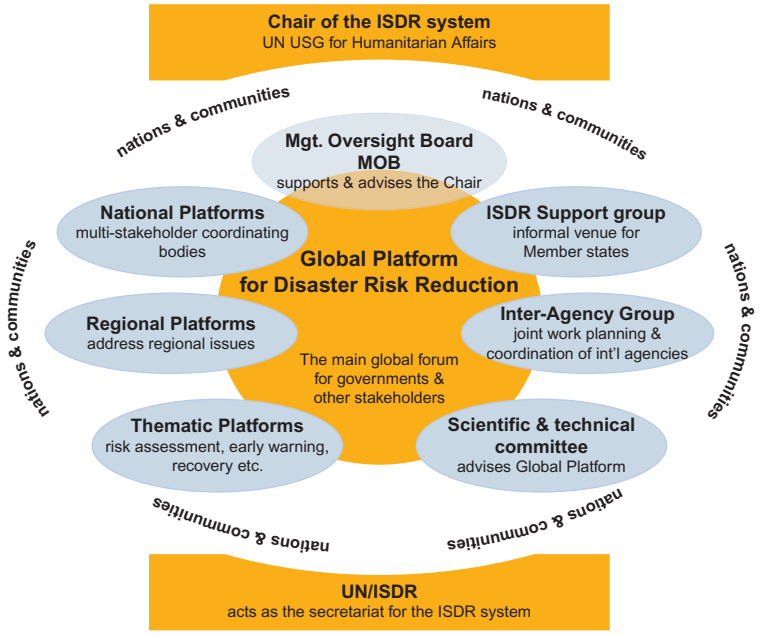

Fig. 1. Elements Consisting ISDR System. (*Source:* http://www.preventionweb.net/english/hyogo/isdr/).

HYOGO FRAMEWORK FOR ACTION 2005–2015: BUILDING RESILIENCE OF NATIONS AND COMMUNITIES TO DISASTERS

The HFA was formulated as a comprehensive, action-oriented response to the growing impacts of disasters on individuals, communities, and national development. Based on trends in disaster risks and practical experience in DRR and intensive negotiations, the HFA was finalized and adopted at the second UN WCDR. The UNISDR served as the secretariat in the process. Substantive reduction in disaster losses is expected through adoption of the HFA, which has three strategic goals and five priorities for action. Following the adoption of the HFA, there has been an increase in global efforts to reduce disaster risks and to tackle vulnerabilities to natural hazards. In the ISDR system, a number of steps have been taken to promote and support the implementation of the HFA focusing on the five key priority areas for action.

HFA Priority 1: Making Disaster Risk Reduction a Priority

For effectively protecting lives and livelihoods threatened by natural hazards, DRR must be a national and local priority with a strong institutional basis for implementation. Countries that develop policy, legislative, and institutional frameworks for DRR and can monitor its progress have greater capacity to spread DRR measures across all sectors of society. To develop institutional capacity, engaging in multistakeholder dialogue will help establish a shared vision, which will simplify implementation of tasks prioritized nationally. It will also help to empower stakeholders who are closer to communities and citizens, and clarify roles of all actors. Also, it will help them create or strengthen mechanisms for systematic coordination among stakeholders. Because DRR is a cross-sectoral issue that requires expertise from various fields, coordination is crucial. For sustainability, DRR should be integrated into development policies and planning as well. To put these activities into action, allocation of appropriate resources by prioritizing DRR will also be critical.

HFA Priority 2: Improving Risk Information and Early Warning

To reduce their vulnerability to natural hazards, countries and communities must be cognizant of the risks. This requires investment in scientific, technical, and institutional capacities to observe, record, research, analyze, forecast, model, and map natural hazards. Tools need to be developed and disseminated, including early warning systems, which can effectively save thousands of lives. In order to determine the needs, country-wide risk assessment should be carried out. This can be used as the basis to identify effective structural and nonstructural mitigation measures. Once risk assessment is carried out, it is important to identify existing capacities and build on top of the country's strengths. If an early warning system does not exist, implement such system to give threatened communities sufficient time to act before devastating damages are done, but with local participation to adapt to the local needs. With such system, strong communication and dissemination mechanisms must be established as well so that the implemented early warning system is understood and reached by all who can benefit from it.

HFA Priority 3: Building a Culture of Safety and Resilience

By being informed of countermeasures to disaster vulnerabilities and having the will to act, disaster risk can be reduced substantially. This means that a

culture of safety and resilience that is embedded in the communities will be an important step toward DRR. Awareness raising through provision of relevant information on risks and protection measures, working alongside media, including DRR into education programs and community activities, DRR capacity trainings, strengthening networks, promoting dialogue and cooperation among experts, and developing or strengthening community-based disaster risk management programs are all activities that can contribute to enhancing communities' culture of resilience.

HFA Priority 4: Reducing the Risks in Key Sectors

Vulnerabilities to natural hazards have increased. Situating communities in hazard-prone areas, environment degradation, unsafe structures, and lack of social and financial safety mechanisms are some examples. A key component of DRR is, therefore, to reduce the known underlying risk factors. A healthy environment can reduce the impact of natural and human-induced disasters and naturally mitigate hazard events. It is beneficial both in protection and in mitigation to incorporate DRR in environmental and natural resources management. It is important to take the most vulnerable communities into consideration because not only are they most vulnerable, but also they have the least ability to recover. By focusing on the protection of the poor, the overall impacts of disasters can be reduced. To better meet such needs, urban and land-use planning, improved building safety and protection of critical facilities, and running potential scenarios can promote increased resilience. Also, creating opportunities for private-sector involvement will further help to reduce the risks of financial ruins post disaster.

HFA Priority 5: Strengthening Preparedness for Response

Effective preparedness at national, individual, and community levels will reduce losses from future disasters. It has been shown that effective disaster response depends on the extent to which diverse actors and entities prepare and operate in a coordinated and timely manner, avoiding gaps, duplications, and parallel structures. To achieve this, developing a common understanding in support of disaster preparedness between local and central authorities, internal and external actors, and within and between sectors is essential. As part of the coordinated efforts, assessing the current capacities and mechanisms and establishing funds are some of the key activities to

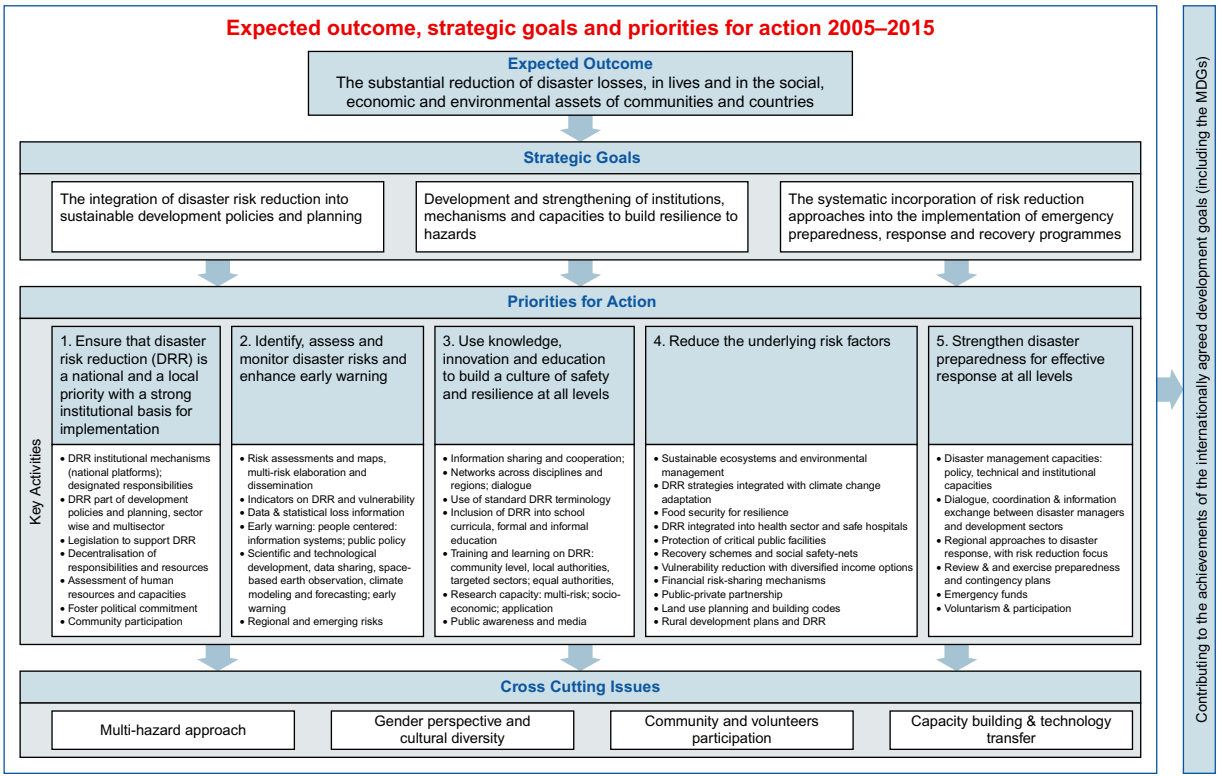

Fig. 2. Summary of the HFA. (*Source:* http://www.preventionweb.net/english/hyogo/framework/).

prepare, which in turn would also facilitate dialogue between agencies, planners, policy-makers, and development organizations. Because it is too late to organize once a disaster has already occurred, ensuring adequate preparation and having contingency plans in place and having the capacity to put those plans into action will be significant to reducing risks for communities.

Through Priorities 1–5, HFA recommends a set of actions to help implement comprehensive DRR. Specific focus on HFA implementation by local governments and stakeholders will be discussed in the next section (Fig. 2).

LOCALIZING HFA IMPLEMENTATION

Translating HFA Implementation into City and Local Levels

The HFA appeals to national governments, while acknowledging the enabling support of international and regional players, to take action so that disaster losses, in terms of lives and social, economic, and environmental assets, are substantially reduced by 2015. To help attain that outcome, it identifies five specific priorities for action. The five priorities are not mutually exclusive, especially when focusing on the processes. The HFA implementing guideline for national governments titled "Words into Action: A Guide for Implementing the Hyogo Framework" was produced in 2007 by UNISDR together with partners to be used as a guideline on what processes governments can take in order to accomplish the five priority actions. There has been progress in implementation of HFA at the national level; however, a strong need for a comprehensive DRR action at the local level has arisen. This is because impacts of disasters are most immediately and intensely felt at the local levels; therefore, the most effective process in which the HFA would be implemented is at the local level, adapted and owned by the citizens and officials of the local government. Through this process, the decentralized local/city governance in DRR activities is strengthened, and stakeholder roles and responsibilities are identified, clarified, and eventually carried out. Each local entity/city is unique in its immediate and long-term needs for DRR. All people and entities have a stake in DRR to protect their lives and livelihoods; therefore, not only should their voices be heard, but also they should be able to participate actively. The HFA will greatly increase in its importance if implemented by local/city governments who have access to those citizens and entities.

To facilitate this process, the development of the HFA implementation guideline for local governments called "A Guide for Implementing the Hyogo Framework for Action by Local Stakeholders" emerged under the initiative called ISDR Asia Regional Task Force on Urban Risk Reduction (RTF-URR), which is one of the regional thematic platforms of the ISDR system.

"A Guide for Implementing the Hyogo Framework for Action by Local Stakeholders" (referred hereon as the Guide) interprets "Words into Action" to use for local-level implementation by customizing the guidelines made for national level. The Guide is not for contingency planning alone, but it is a tool for development as well as local/city governance. By using this guideline, stakeholders may identify the gaps in its DRR plans and activities, which will allow them to then seek appropriate partnerships and networks to work together for safer communities. Thus, putting this Guide to use requires an arena or forum by which people of different backgrounds and affiliations can share experiences, uncertainties, knowledge, and success stories of others. This forum is referred to as a "platform." The platform of multistakeholders will thus serve as an advocacy tool of DRR in the local context. It will facilitate coordination and participatory process engaged in problem solving based on evidence. Resources from various areas will be combined. Also, it will streamline the planning process so that DRR can be accepted as a public value and be mainstreamed into local/city plans as well as day-to-day operations of constituted authorities and businesses.

Outline of "A Guide for the HFA Implementation for Local Stakeholders"

"A Guide for the HFA Implementation for Local Stakeholders" targets local/city government officials and staff as well as communities and institutions that interact on a daily basis and are geographically tied by administrative boundaries or natural physical boundaries. Other actors can also benefit from the Guide. It consists of introduction and five parts, detailing recommended processes of local implementation for each key priority action area of the HFA. Each part is organized into six items:

1. Brief introduction
2. Note on the key stakeholders
3. Indicators for monitoring progress
4. Summary table of tasks with guide questions
5. Descriptions of useful tools

6. Some concrete examples introduced in boxes to illustrate tasks as practiced (a few tools and methodologies are also selectively discussed to provide insights into the type of activities that may be required of partners)

The reader is presented with a list of relevant stakeholders at the beginning of each part. Each reader will assess their own context and recall relevant local actors, which will also help to identify the strengths and weaknesses unique to him or her. Then the reader is guided through the assessment of current status of his or her organization or community through provided indicators of implementation progress. A summary table is available at the end to identify local or city-level DRR tasks that need to be performed and tools to be used, with description of each and case studies illustrating how those were implemented successfully. This helps the readers to see the steps to follow in an organized fashion and determine ways to bring about meaningful changes in their communities.

Tasks and Tools Suggested in the Guide

In the ''Words into Action,'' 22 tasks are identified to implement HFA priority for action. According to the ''Words into Action,'' each task is a primary area of effort for implementing DRR and can be used to monitor achievement by using them as indicators of progress. The 22 tasks of ''Words into Action'' were adapted to be used at local/city levels, and a slightly modified version of the list of 20 tasks was used in the Guide for local/city government's use (Table 1). Breaking down a problem into its components often helps to simplify and understand the situation. Each component may have its unique solution, and different tools can be used to reach such solution. Tools are best utilized by help from trained professionals to different sectors. Table 2 lists a sample of tools mentioned in the Guide that would be helpful in accomplishing the tasks given in each HFA priority area. The Guide also gives detailed descriptions of these tools, including their purpose, relevance, and use.

Indicators and the HFA Strategic Goals

Assessment must be built into all levels of the program and project activities. Reporting back the results and giving feedback help sustain interest among

Table 1. Twenty Tasks Drawn from Five HFA Priorities to Be Implemented by Local Stakeholders.

Local/city governance (HFA Priority 1 related)
- Task 1. Engage in multistakeholder dialogue to establish foundations for disaster risk reduction.
- Task 2. Create or strengthen mechanisms for systematic coordination for DRR.
- Task 3. Assess and develop the institutional basis for DRR.
- Task 4. Prioritize disaster risk reduction and allocate appropriate resources.

Risk assessment and early warning (HFA Priory 2 related)
- Task 5. Establish an initiative for community risk assessment to combine with country assessments.
- Task 6. Review the availability of risk-related information and the capacities for data collection and use.
- Task 7. Assess capacities and strengthen early warning systems
- Task 8. Develop communication and dissemination mechanisms for disaster risk information and early warning.

Knowledge management (HFA Priority 3 related)
- Task 9. Raise awareness of DRR and develop education program on DRR in schools and local communities.
- Task 10. Develop or utilize DRR training for key sectors based on identified priorities.
- Task 11. Enhance the compilation, dissemination, and use of DRR information.

Vulnerability reduction (HFA Priority 4 related)
- Task 12. Environment: incorporate DRR in environmental management.
- Task 13. Social needs: establish mechanisms for increasing resilience of the poor and the most vulnerable.
- Task 14. Physical planning: establish measures to incorporate DRR in urban and land-use planning.
- Task 15. Structure: strengthen mechanisms for improved building safety and protection of critical facilities.
- Task 16. Economic development: stimulate DRR activities in production and service sectors.
- Task 17. Financial/economic instruments: create opportunities for private sector involvement in DRR.
- Task 18. Emergency and public safety; disaster recovery: develop a recovery planning process that incorporates DRR.

Disaster preparedness (HFA Priority 5 related)
- Task 19. Review disaster preparedness capacities and mechanisms, and develop a common understanding.
- Task 20. Strengthen planning and programming for disaster preparedness.

Source: "A Guide for Implementing the Hyogo Framework for Action by Local Stakeholders."

the stakeholders as well as learning from the experience. It is important for the city government to acknowledge achievement of participating stakeholders so that their activities link to a sense of accomplishment. The 20 tasks outlined in the Guide can be used as indicators of progress to measure

Table 2. Tools Listed in the Guide for Implementing HFA by Local Stakeholder.

HFA Priority 1 – related tools
Focal point for disaster risk reduction
Multistakeholder dialogue
Disaster risk reduction framework and action plan
Stakeholder engagement/coordination mechanisms
HFA Priority 2 – related tools
Risk communication and dissemination mechanisms for disaster risk information
Early warning systems
Community risk assessment
Gap analysis (including risk-related information)
HFA Priority 3 – related tools
Disaster information system
Public disaster awareness raising program/strategy
Training programs and networks in support of DRR
HFA Priority 4 – related tools
Disaster recovery plan
Environmental impact assessment
Financial/economic instruments
Poverty reduction program/strategy
Promoting building safety and protection of critical facilities
Risk-sensitive urban and land-use planning
Sectoral subwork groups to stimulate DRR activities in production and service sectors
HFA Priority 5 – related tools
Disaster preparedness planning and programming
Capacity assessment of disaster preparedness and mechanisms

Source: "A Guide for Implementing the Hyogo Framework for Action by Local Stakeholders."

such achievement. These indicators contribute to the attainment of the following three strategic goals specified within HFA (Hyogo Framework for Action 2005–2015: Building the resilience of nations and communities to disasters, 2005):

1. The more effective integration of disaster risk considerations into sustainable development policies, planning, and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness, and vulnerability reduction;
2. The development and strengthening of institutions, mechanisms, and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience to hazards; and

3. The systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response, and recovery programs in the reconstruction of affected communities.

The guide seeks to support the measurement of progress in DRR at local/city level, which is why the indicators are consistent with the strategic goals, five priorities for action, and other relevant tasks that are also being implemented by the national government. Summary tables of the HFA five priorities for local stakeholders (A Guide for the HFA Implementation for Local Stakeholders, 2010) can be used as the guiding tool for local governments and stakeholders' planning processes to identify gaps in their existing plans. The guiding questions and tools can also be utilized to start taking actions to close the identified gaps so that more comprehensive DRR actions and planning can be implemented based on the HFA requirements.

RESILIENCE MAPPING THROUGH CDRI AND LOCALIZING HFA

Climate and Disaster Resilience Initiative

As mentioned in the earlier chapters, the Climate and Disaster Resilience Initiative (CDRI) was started in 2008, led by the Kyoto University in cooperation with CITYNET, UNISDR, and SEEDS. City profile analyses are done based on questionnaire surveys filled out by city officials (City Profile: Climate and Disaster Resilience, 2009). Despite the differences among cities, there are areas in cities that frequently rate high and low; this means that there are strengths areas as well as weakness areas that are common among participating cities. For instance, many of these cities' populations were relatively young, have low water and vector-borne diseases, have continuous electricity, and have high electricity. These are all characteristics that make cities resilient to climate-induced disasters. On the other hand, low percentage of households owning nonmotorized vehicles, low percentage of cities' households' properties under insurance schemes, poor access to catastrophe risk financing instruments, and high percentage of unemployment in formal sectors as well as high percentage of employment in informal sectors are all factors that exacerbate the risks faced by the participating cities. Also, the results of the survey showed that most cities perceive similar aspects of DRR to be more important than others. While community participation was consistently perceived as

important, social desegregation, low water table, and food security were all ranked low in the perceived importance. Climate Action Plans (CAP) were developed in each participating city. After resilience mapping using city profile, cities set priorities based on the results, create the action plans, and implement them. Once implemented, plans are evaluated and modified based on lessons learned to continuously implement the updated plans. This systematic approach enables cities to be clear of the necessary tasks and steps as well as what they need to avoid in the process. The implementation of the devised action plans through the CDRI capacity-building program and following up the progress to evaluate the outcome will be an ongoing process; however, if it is believed to be successful, this can be an enormously useful sustainable tool for cities across the globe.

CDRI is a high-resolution tool to facilitate local HFA implementation. It was developed in order to create an evidence-driven process at local levels. Although it is still in its pilot phase, it shows tremendous promise to guide cities to systematically implement the key tasks provided in the Guide, adapted from the HFA. In the coming five years until the conclusion of HFA 2015, it will be imperative to continue to make the case for localizing HFA and implementing DRR at local as well as national levels as climate change continues to haunt the cities and its citizens. The local and national implementation should occur simultaneously in order for governments to achieve best DRR practices.

HFA and CDRI Synergy at Local Level

CDRI is considered as one of the useful tools for implementing HFA at the local level. The language of the CDRI and HFA is different. The HFA is a low-resolution guidance document providing five priority areas to take actions on comprehensive DRR, and at the same time it was designed to be generic and does not include too much detail (which may or may not be applied to all the countries) in order to facilitate and ensure that all UN member states adopt it. On the other hand, the CDRI is a high-resolution document. It has more details and contains 125 specific indicators. The two documents can be used simultaneously to effectively address urban resilience issues. When CDRI and HFA are put in the form of a matrix of CDRI–HFA linkages (Fig. 3), it provides an overall and holistic assessment of the tasks performed required to implement HFA, which links to specific city services like physical resilience (water, sanitation, or other infrastructures) or social and economic resilience. CDRI facilitates city governments to

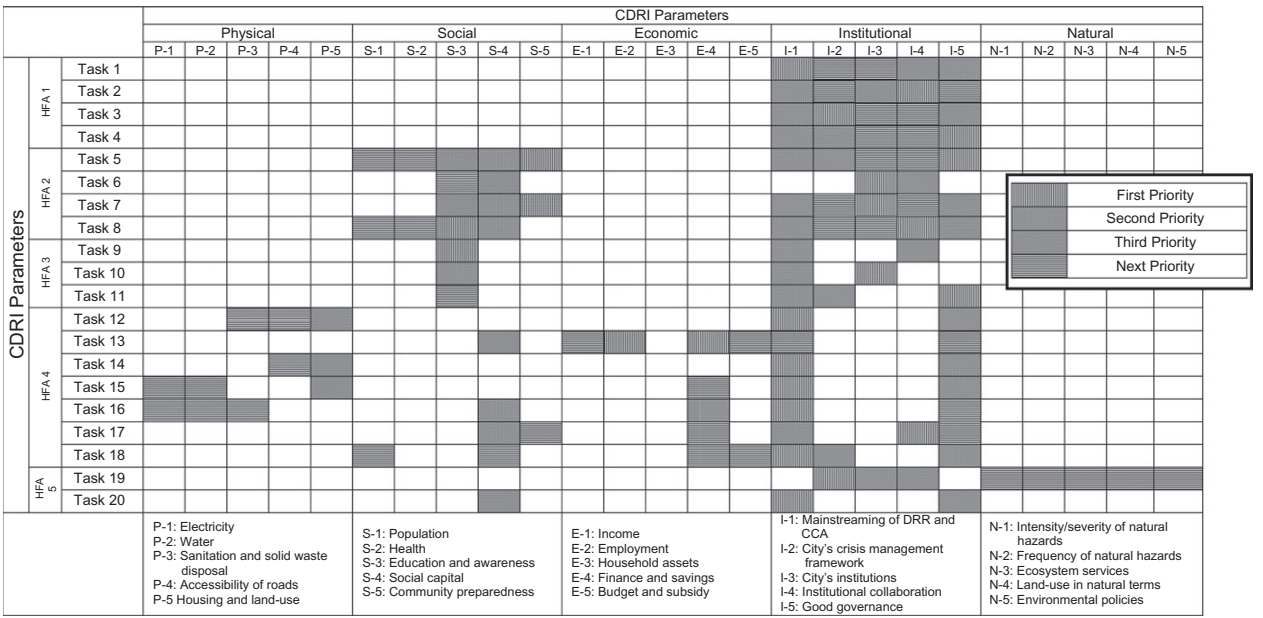

Fig. 3. HFA–CDRI Linkage Matrix. (*Source:* Climate and Disaster Resilience Initiative-Capacity-building Programe, 2010).

identify specific areas they need to address and take actions from practical perspective, and at the same time ensures these efforts are aligned to implement comprehensive DRR policies along with the HFA implementation that is the globally adopted policy guidance. As Fig. 3 shows as an example of inserting action plans by a city into the HFA–CDRI linkages matrix, city governments also can identify short-term, mid-term, and long-term priorities along with CDRI parameters and action plans. HFA–CDRI linkages matrix demonstrated how these short-term, mid-term, and long-term priorities identified by a city lead to HFA implementation. Synergy and linkages between HFA and CDRI facilitate city governments to implement HFA from practical perspective by linking HFA-required tasks into city government's specific services, and also would help city governments to identify what are the gaps and missing areas in order to implement HFA-comprehensive DRR.

ISDR World Disaster Reduction Campaign 2010–2011 "Making Resilient Cities"

Since the adoption of the HFA at the WCDR in 2005, efforts to reduce disaster risks and tackle vulnerabilities to natural hazards have accelerated globally. While recognizable progress in HFA implementation has been made at international, regional, and national levels, efforts at local levels must be scaled up. To address this issue, UNISDR has launched the ISDR World Campaign on Disaster Risk Reduction 2010–2011 with the theme "Making Cities Resilient." The UNISDR secretariat, the coordinator of the campaign, is working with its partners to raise awareness and commitment for sustainable development practices that will reduce disaster risk and increase the well-being and safety of citizens and urban centers. The aim is to invest today for a better tomorrow. Building on previous ISDR campaigns focusing on education and safer hospitals and schools, ISDR partners are urging city leaders and local governments to commit to work alongside local activists, grassroots networks, and national authorities to reduce the risk of disasters arising from natural hazards to make cities more resilient to disasters.

The campaign targets mayors, local governments, and national authorities to take actions toward making cities resilient as part of sustainable urbanizations. Empowering local government officials and institutions to make cities resilient is vital to make progress on local implementation. The campaign seeks to raise awareness and bring about change by urging local

governments to take action now to reduce cities' risk to disasters and create more resilient and sustainable urban communities. To do this, the campaign has three objectives to be achieved through building lasting partnerships (The Info Kit of the ISDR 2010–2011 World Disaster Reduction Campaign, 2010):

- Know more, by raising awareness of citizens and governments at all levels of the benefits of reducing urban risks;
- Invest wisely, by identifying budget allocations within local government funding plans to invest in DRR activities; and
- Build more safely, by including DRR in participatory urban development planning processes and protect critical infrastructure

As a guideline, the campaign proposed a checklist of Ten Essentials for Making Cities Resilient (Table 3). This is derived from the five priorities of HFA. It is designed so that achieving all, or even some, of these essentials will help cities become more resilient.

The ten-point checklist is useful for cities to provide an opportunity to think and check on their areas of work on DRR. However, this is an advocacy tool and a low-resolution list of items for city governments. Therefore, to further step forward to take concrete actions on DRR, more detailed methodology like CDRI is of great use and efficiency. With this perspective, while using a simple advocacy ten-point checklist, the ISDR campaign on making cities resilient has recognized and highlighted the CDRI as one of the very useful and concrete initiatives to support resilience building of city governments.

CONCLUSION: CHALLENGES AND WAY FORWARD TOWARD 2015

The HFA has indeed been an extremely useful framework in guiding the DRR work at all levels. It facilitates a comprehensive approach to DRR, and is used by governments, civil society organizations, international agencies, and in some cases academic institutions to guide and align their work and efforts. However, it has also become a ''catch-all'' framework to some, and countries label activities as contributor to a particular HFA priority for action without understanding the significance of such activities and priorities. Another issue is that the interlinkages between the five priorities are also not sufficiently articulated in the design and

Table 3. Ten-Point Checklist as Essential for Making Cities Resilient.

1. Put in place organization and coordination to understand and reduce disaster risk within the local government, based on participation of citizen groups and civil society–build local alliances. Ensure that all departments understand their role and contribution to disaster risk reduction and preparedness.
2. Assign a budget for disaster risk reduction and provide incentives for homeowners, low-income families, communities, businesses, and public sector to invest in reducing the risks they face.
3. Maintain up-to-date data on hazards and vulnerabilities, prepare risk assessments, and use these as the basis for urban development plans and decisions. Ensure that this information and the plans for your city's resilience are readily available to the public and fully discussed with them.
4. Invest in and maintain critical infrastructure that reduces risk, such as flood drainage, adjusted where needed to cope with climate change.
5. Assess the safety of all schools and health facilities and upgrade these as necessary.
6. Apply and enforce realistic, risk-compliant building regulations and land-use planning principles. Identify safe land for low-income citizens and develop upgrading of informal settlements, wherever feasible.
7. Ensure education programs and training on disaster risk reduction are in place in schools and local communities.
8. Protect ecosystems and natural buffers to mitigate floods, storm surges, and other hazards to which your city may be vulnerable. Adapt to climate change by building on good risk reduction practices.
9. Install early warning systems and emergency management capacities in your city and hold regular public preparedness drills in which everyone participates.
10. After any disaster, ensure that the needs of the survivors are placed at the center of reconstruction with support for them and their community organizations to design and help implement responses, including rebuilding homes and livelihoods.

Source: The Info Kit of the ISDR 2010–2011 World Disaster Reduction Campaign (2010).

implementation of DRR initiatives. Through the ISDR World Disaster Reduction Campaign 2010–2011, a number of good tools and examples in localizing HFA is being showcased. CDRI should be highlighted as one of the prominent examples. It is a practical and successful demonstration on localizing HFA implementation, and it can also be a valuable input to the HFA mid-term review to speculate on strategies toward 2015 and beyond HFA.

An increased emphasis on scaling up localization of HFA is necessary over the next five years toward 2015. Concrete examples, practical cases and analysis, and demonstrative methodologies in localizing HFA, such as CDRI, can contribute to instigating future frameworks on DRR post HFA. One of the key themes in the successor of HFA should be local actions on

DRR with quantitative targets and indicators that would allow for a more systematic approach and evidentiary base for actions. To facilitate further local implementation of DRR, a greater decentralization process empowering local authorities is critical, while strengthening national capacity to support local authorities to reduce disaster risks. Because the tools and guidelines provided through the HFA and its related documents are not one-size-fits-all (and it may never be), countries themselves need to adapt and learn from the guidelines and capacity development programs as well as partnerships they build through implementation process in order to increase awareness among its citizens and strengthen the culture of resilience that is most relevant to their context. An international and regional organization's initiatives and guidance can only facilitate and support these activities, but it heavily replies on capacities of the individual governments, both national and local, and its people to prepare and reduce risks to protect itself from future disasters.

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CHAPTER 8

FROM RESILIENCE MAPPING TO ACTION PLANNING

Glenn Fernandez, Yukiko Takeuchi and Rajib Shaw

INTRODUCTION: THE IMPORTANCE OF ACTION PLANNING

Climate and disaster resilience mapping has been discussed in detail in Chapter 3. The Climate Disaster Resilience Index (CDRI) as a comprehensive and well-structured methodology for measuring the resilience of cities is presented, as well as the differences between CDRI and various assessment tools. The resilience of cities, or their agglomerations or subzones, is being measured because cities are seen to be at a suitable level to efficiently initiate action, especially in developing countries where unplanned or haphazard urbanization is a major risk factor. But for climate and disaster resilience mapping to be of value, it should be followed by action planning. Having a vision for the future and charting a course to achieve it is what action planning is about. Studies have consistently shown that vision, planning, and goal setting can positively influence cities' organizational performance. Action planning can compel future thinking, highlight new opportunities and threats, and refocus a city's mission. Productive action planning focuses on the most critical problems, choices, and opportunities. Action planning requires time and a process. If used effectively, it is a powerful tool for self-management and goal-based achievement. Action planning typically includes deciding who is going to do what and by when and in what order

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for the city to reach its long-term goals. The design and implementation of the action planning depend on the nature and needs of the city.

There are many different models of action planning, but these models all show that action planning is a cyclical process. Of course, in reality, it is not quite as simple as this. The process is more organic and stages will overlap, cities may change their goals as they progress, and cities must be prepared to revise their plan as circumstances dictate. Usually, prior to action planning, there is little guidance, regulation, or coordination of climate change adaptation and disaster risk reduction at the city level. An action plan provides the needed roadmap. It is a simple list of all of the tasks that need to be carried out to achieve an objective. To use it, the cities simply carry out each task in the list. In this study, action planning is a collective exercise of city departments, and the output will be short-, medium-, and long-term priority of actions to enhance the city resilience to climate and disaster risks.

USAGE OF ACTION PLANNING BY DIFFERENT LOCAL GOVERNMENTS

To illustrate the importance of action planning, several actual usages of the approach had already been documented. In 1996, the RADIUS (Risk Assessment Tools for Diagnosis of Urban Areas against Seismic Disasters) initiative was launched to promote worldwide activities for reduction of seismic disasters in urban areas, particularly in developing countries (Okazaki et al., 2000). From January 1998 through October 1999, the RADIUS project's case studies were implemented in nine cities around the world, namely, Addis Ababa, Ethiopia; Antofagasta, Chile; Bandung, Indonesia; Guayaquil, Ecuador; Izmir, Turkey; Skopje, TFYR Macedonia; Tashkent, Uzbekistan; Tijuana, Mexico; and Zigong, China. During the project's implementation, the earthquake risk of each of the case-study cities was assessed and the potential damage caused by a probable earthquake was described in an earthquake scenario. The results of the risk evaluation were used, working closely with local institutions and experts, to prepare an action plan that would reduce the city's risk. The proposed action plan prioritized the necessary actions so that they could be implemented soon after the project. To facilitate immediate implementation, the action plan, therefore, had to be practical. The earthquake scenario and action plan were then disseminated to relevant organizations and the public. Another example is the participatory action planning conducted in five peri-urban villages in the Hubli–Dharwad

twin city region of India to enhance the livelihood of the poor and manage the natural resource base (Halkatti, Purushothaman, & Brook, 2003). One outcome of the action planning process was the emergence and prioritization of issues by the community. Recognizing that climate change is a global problem with significant impacts at the local scale, the Cornwall County Council in the UK developed action plans for its "Climate Change Strategic Framework," with targets and key priorities included as integral elements (Cornwall County Council, 2007). The action plans were designed to be precise, realistic, measurable, and set within a defined time frame: short, medium, and long term. Progress against actions is to be reported on an annual basis.

To help address the concern of protecting its distinctive quality of life, the City of Pasadena in California, USA, launched a comprehensive environmental action plan that will guide the city toward sustainability and accelerate the city's environmental commitment (Pasadena City, 2006). The goals contained within the "Green City Action Plan" follow the United Nations Urban Environmental Accords of 2005, which acknowledge the environmental challenges and opportunities facing urban areas across the globe. Pasadena's Green City Action Plan contains a wide range of initiatives that form a strategy toward fulfilling the ambitions of the Urban Environmental Accords, like means to conserve energy and water, reduce waste, address global warming, tailor urban design, protect natural habitats, improve transportation options, and reduce risks to human health.

For its part, the City of Fort Collins created an "Action Plan for Sustainability" to provide recommended policy, goals, and targets for advancing sustainability within city operations (Fort Collins City, 2004). A staff team with representatives from service areas across the city developed the action plan. The team then prioritized nine areas of key importance to the city from a list of 31 sustainability topics for local governments and developed goals and quantitative targets for each of the nine priorities. Each target contains four elements: performance measure (how results will be quantified), scope (what part of the operation will be measured), performance goal (what the desired outcome is), and completion date (when the outcome will be achieved). Similarly, the City of Chicago, Illinois, USA, also employed a cross-functional group of hundreds of individuals, funders, businesses, and organizations that comprise its Chicago Climate Task Force that prepared a list of 35 actions to ensure a city resilient to climate change (Chicago City, 2009). Likewise, the preparation of Bangkok's "Action Plan on Global Warming Mitigation 2007–2012" involved receiving opinions and suggestions from the people of Bangkok, which were put together and refined into

5 initiatives and 10 action plans by number of interdisciplinary experts (Bangkok Metropolitan Administration, 2007).

For the City of Berkeley, California, USA, the development of its ''Climate Action Plan'' began in November 2006, when Berkeley voters issued a call to action on the climate challenge by overwhelmingly endorsing a measure mandating the reduction of the entire community's greenhouse gas (GHG) emissions by 80% by the year 2050 and directing the mayor to develop an action plan to reach that target (Berkeley City, 2009). The city believes that turning the vision and the plan into action requires everyone in the Berkeley community to play a role. Thus, a public engagement process was designed to maximize the opportunities for community members to contribute ideas, learn more about the various components of the climate issue, and get involved in existing sustainability efforts. Opportunities for public engagement in the development of the action plan included a kickoff event in May 2007, which was attended by over 170 community members; a summary report released in June 2007 that outlines where Berkeley's GHG emissions come from; and some potential emissions reduction strategies, and invites community input on Berkeley's Climate Action Plan, climate action workshops for the purpose of providing a forum for participation in plan development, community events and meetings, e-mails, phone calls, and online forums. The city also solicited ideas and feedback on its specifically designed Web site (www.BerkeleyClimateAction.org). At the invitation of the mayor, a number of local experts in the fields of climate science, energy, transportation, and public engagement also served as informal advisors. In addition, the University of California faculty, staff members, and student leaders contributed to the plan through their research, volunteerism, and guidance.

Not surprisingly, every city action plan on disaster risk reduction will be different, given the fact that every city has a unique mix of people, priorities, resources, and traditions. Nevertheless, the best planning is informed by ''environmental scanning,'' which includes exploring the action plans of other cities in order to discover lessons learned and best practices and to avoid the costly mistake of reinventing the wheel.

ACTION PLANNING PROCESS

CDRI Action Planning

The CDRI Action Planning started in 2008 with 15 cities across Asia: Banda Aceh, Indonesia; Bangkok, Thailand; Colombo, Sri Lanka; Danang, Vietnam;

Dhaka, Bangladesh; Hanoi, Vietnam; Ho Chi Minh, Vietnam; Hue, Vietnam; Iloilo, Philippines; Makati, Philippines; Mumbai, India; San Fernando (La Union), Philippines; Sukabumi, Indonesia; Suwon, South Korea; and Yokohama, Japan (Shaw et al., 2009). The CDRI was used in resilience mapping. Afterward, a self-evaluation matrix (SEM) was utilized to identify priorities to be addressed by each city after the resilience mapping. In 2009, shortly after Typhoon Ketsana *(Ondoy)* affected the entire Metro Manila, a CDRI action planning was done at the Makati City Hall with the participation of representatives of the Planning Office of 12 out of 17 cities of Metro Manila. The 22 participants were divided into five groups, corresponding to the five dimensions of disaster resilience: physical, social, economic, institutional, and natural. Each group was tasked to list down specific actions that could be performed by the cities to contribute to enhancing Metro Manila's disaster resilience (Shaw, Takeuchi, & Fernandez, 2010).

And then in 2010, a CDRI capacity-building program was conducted by the Kyoto University Graduate School of Global Environmental Studies (under the Global COE Program of "Human Security Engineering in Asian Megacities"), CITYNET (Regional Network of Local Authorities for the Management of Human Settlements), Tokyo Distance Learning Center (TDLC) of the World Bank (Global Development Learning Network), United Nations International Strategy for Disaster Reduction (UNISDR), Sustainable Environment and Ecological Development Society (SEEDS), and Asia Regional Task Force on Urban Risk Reduction (RTF-URR); eight cities participated in the program: Chennai, India; Colombo, Sri Lanka; Dhaka, Bangladesh; Hue, Vietnam; Kuala Lumpur, Malaysia; Makati, Philippines; Sukabumi, Indonesia; and Suwon, South Korea. One of the objectives of the program was to guide the participating cities in initiating their Climate Action Plan process and implementation process. Fortunately, the steps required to create a successful action plan are fairly straightforward and well within the capabilities of any city. Every city has individuals, often in several departments, with the skills to lead or facilitate an action planning process. The next section lays out an overview of the steps of this important process.

Steps of Action Planning

The capacity-building program recommended the following six-step action planning process to help cities make decisions and plans systematically, thereby increasing the probability of achieving their goals. The process will give the cities a clear picture of where they are going, a map of the steps to

get there, a sense of the pitfalls to be avoided along the road, and the means to assess their success. As mentioned in the Introduction section, the steps do not have to be linear; some can overlap or be performed simultaneously.

Resilience mapping: resilience mapping can be used as an organizing, learning, and advocacy tool. Resilience mapping is about putting current city information into a graphic representation and helping cities to collectively understand the big picture. By understanding the CDRI analysis results, the city can assess the strengths and weaknesses of its physical, social, economic, institutional, and natural resilience. This can provide a starting point in looking for solutions to address the city's climate and disaster resilience problems. To be useful, the CDRI analysis results must be interpreted using language and words that are easy for all the city stakeholders to understand.

Setting priorities: city governments usually have very limited budgets and other resources devoted to disaster risk reduction and climate change adaptation efforts. Therefore, it is necessary to set priorities in order to get meaningful results accomplished. Based on the preceding resilience mapping and using an SEM, the city can identify key priority areas in different planning horizons: short-term (between now and the next two years), medium-term (for the next two to five years), and long-term (beyond five years). In this step the city moves ahead from data analysis to reasoning and finding solutions. The SEM helps identify generic priority areas and reflect upon them, paving the way for policy and action planning. Facilitated workshops involving multiple stakeholders, who are actually the local experts, are necessary to establish priorities in a participatory manner. The objectives of the workshops at this stage are to assemble a cross-functional core team that will lead the Climate Action Plan program, educate the team about CDRI findings and their implications, and evaluate and prioritize action areas. These initial workshops are a critical first step. City leaders should assist participants in establishing processes to ensure that resulting priorities are agreed to and followed and that communication strategies are in place to engage the rest of the actors in the succeeding steps (Fig. 1).

Creating the action plan: using the priority areas identified in the previous step, the team is required to come up with a list of specific implementable actions, i.e., projects and programs. Using brainstorming, it is helpful to write down all actions team members think may be needed to achieve the goal of becoming a climate and disaster resilient city. At this step the team members must focus on generating and writing as many different options and ideas as possible. The next part will be to analyze and prune the initial list of actions to what are absolutely necessary and effective steps to achieve the city's goal. Actions without significant consequences to the desired outcome can be

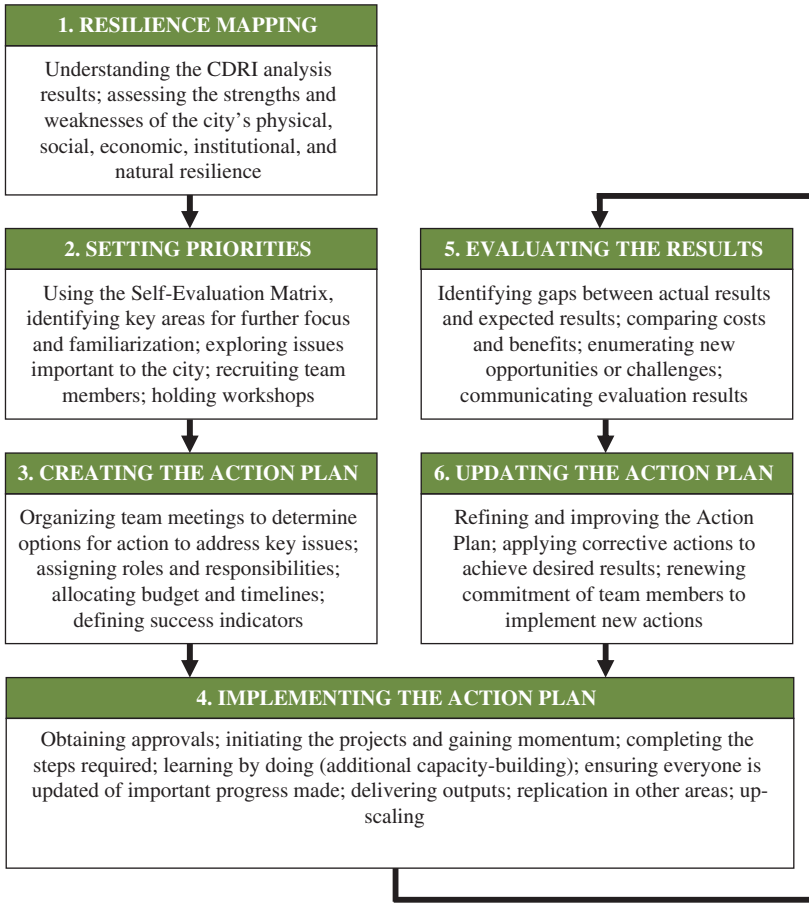

Fig. 1. The Action Planning Process.

crossed out from the list. The remaining action can then be organized according to the chronological sequence in which they will be implemented. This exercise will enable the team members to perform cost–benefit analysis, identify resources needed, and assist in identifying areas where people can work together. A key step in evaluating projects is to investigate financing opportunities and constraints. Sources of funding will heavily affect decisions on which projects can be considered feasible. It is important that cities exercise creativity and resourcefulness especially when considering crucial but financially ambitious

projects. Because no single project can accomplish everything, the typical approach is to explore a wide variety of possible projects and actions. This is called the portfolio approach (Eagan et al., 2008). A short list of feasible projects and programs may have to be presented to senior management of the city for approval. Many action plans fail because the actions appear too difficult. The team members are most likely to make progress if they break down the actions they have to do into small tasks and then identify the steps needed to be taken for each task. Set a timeline for each step but be realistic. Do not expect the impossible. Remember that the action steps and their timelines are only guidelines, not rules set in stone. They can be deviated from, but deviations should be understood and explained. The cities are encouraged to start planning the immediate implementation of more simple projects and programs first, before moving to very complex and more difficult types of actions. Action generates the impetus for further action. As emphasized in the CDRI capacity-building program, now is the time to convert plans into action. One or two small concrete actions started immediately can help propel the cities into taking bigger actions in climate urban resilience enhancement in the future. Action plans usually include the following elements: action steps to be taken, start date, completion date, participants, staff responsible, methods, resources required, expected output, performance indicators, etc. The main result of action planning should be the decision to solve one or more of the city's problems through the preparation of projects and programs. A project is simply a specific activity designed to solve a specific problem, e.g., rainwater harvesting to provide households with alternative source of water for flushing toilets, washing laundry, watering plants, etc. In the CDRI capacity-building program, each participating city was required to prepare its own set of city Climate Action Plan documents, which include the following:

1. City Profile
2. Summary of CDRI Findings
3. Policy Implications in Relation to the HFA Priorities for Action
4. Identified Stakeholders
5. Key Local Development and Disaster Plans
6. Policy Directions
7. Short,- Medium-, and Long-Term Priority Areas and Specific Actions
8. Way Forward for Fund Mobilization
9. Monitoring Indicators

Implementing the action plan: One of the biggest problems in action planning is that the resulting action plan is not implemented. There are several reasons why this happens, like lack of strong leadership or shortage

of funds and other resources. The implementation stage can be considered a test of a city's commitment to action planning. A city's purposefulness is proportional to the extent that the city completes the set of required action plan documents and the actual extent of implementation of the action plan. To be effective, implementation of action plans should occur quickly, while the inertia from the previous stages is still there. As mentioned earlier, the city can start immediately with small projects. It is essential that adequate support and encouragement is given to groups performing the implementation to enable them to work effectively together in a positive atmosphere and to ensure that good leadership within the group is established. The nature of different projects will require different attitudes and approaches to be developed within groups. City projects may involve large numbers of people working together for a relatively short period of time. Important features here will be good leadership and coordination skills. Effort may be needed to keep people involved and to make a fair contribution. Delegation of responsibilities may be essential. Overall the process of implementation requires discipline to get projects and programs done, the ability to anticipate and solve problems, and the ability to keep adequate records and monitor progress.

Evaluating the results: this stage will help in identifying problem areas and where deviation from the timelines of succeeding projects and programs might occur so that early corrective action can be taken, e.g., putting in more resources. The city should monitor the execution and measure the progress of projects and programs with respect to targets or indicators previously prepared. It is important to communicate progress to all team members and share best practices between subgroups. Therefore, a good documentation is essential. When new information become available, use them to further adjust and optimize your action plan. Participatory monitoring and evaluation are important to improve the processes and methods used by the implementers, as well as the effectiveness and ultimate impact of projects and programs themselves. Meetings or learning workshops might need to be conducted for this purpose. It is important that joint observation and reflection will lead to corrective actions for future action planning and implementation.

Updating the action plan: action planning is an ongoing process involving continuous improvement. The action plan is updated as the city goes along with any additional necessary activities that come up. So it is very useful to ensure that the city continually monitors and reviews the progress of the action plan implementation and notes major lessons learned. This also helps prepare projects and programs for the next year. Useful and effective ideas, knowledge, techniques, and tools get shared with all involved.

The recommended six steps explained above are intended to guide cities in proceeding to conduct action planning. Each city, however, has to chart its own course to some extent, adapting existing templates and methodologies to its own unique circumstances, learning along the way how to perform its own brand of action planning. The action plan is a work in progress, so the city will have numerous opportunities to adjust their action planning until it comes up with a process that it is comfortable with and that is effective for its context. Getting the process right is a unique city-by-city experience.

CHALLENGES IN ACTION PLANNING

Looking at the process flow chart, action planning might seem an uncomplicated and straightforward process. However, actually going through it can be challenging especially for very large cities and for cities doing it for the first time. The action planning process is intimately tied to each city's values, traditions, decision-making pathways, finances, and human resources. And it is important to familiarize the city's strategic plan before Climate Action Plan can be started. There is no step-by-step cookbook guide on Climate Action Plan efforts that will be applicable to any city. Cities have to improvise as they go through the process. There are some obvious steps, as recommended above, but each step must be tailored to each city for a site-specific and successful fit. A formal, high-level commitment is often the starting point of the action planning process in the cities. This can be manifested through public statements or policies set forth by top leadership, e.g., by the city mayor or the city council. Once such a commitment is made, it becomes the guiding authority for action and sets the wheels in motion. This commitment will later influence the actual implementation of the action plan. Without this support from the city leaders, action planning will likely not be sustained or will not take place at all.

Another important issue in action planning is funding. This was specifically raised by participants in the CDRI capacity-building program in Kuala Lumpur, Malaysia (Shaw et al., 2010). Not encouraging the participating cities to be always dependent on external support, the workshop organizers explained to the participants that the beauty of the entire capacity-building exercise is that the city has ownership of the projects that they will implement. So the cities are encouraged to implement activities that are self-financed. Pursuing external funding from donors might also take time. One suggestion is for the cities to integrate their activities in existing development projects that already have funding. The problem of funding was also encountered in the

RADIUS project (Shaw, 2001; Villacis, 2001). Most case-study cities reported that only a small fraction of their action plan had been implemented. The lack of funding was identified in most cities as the cause for not having more of the action plan implemented. In addition, cities in politically unstable countries, such as Guayaquil, Ecuador, faced political, social, and economic hardships that prevented further advancement in the implementation of their action plan. Cities might also have to contend with changes in city leadership. While some cities may properly manage the changes and gain the support of the new administration, some new city officials might have other agenda and be hesitant to adopt the Climate Action Plan produced in the previous administration. Because of this possibility, it is advisable to "institutionalize" approved Climate Action Plans through city resolutions, decrees, or similar instruments to ensure that even if city leadership changes, the commitment and budget to implement the prepared and approved Climate Action Plan will still be there. In the RADIUS project, several cities cited that incorporating the project results into the city activities could ensure better results, and some had achieved some progress in this respect (Shaw, 2001). For example, in Bandung, efforts were being made to include the action plan in the city's five-year development plan. In Tashkent, the mayor decreed the action plan as the official action plan for risk reduction activities in the city and ordered the respective city departments to implement the plan's activities. In Zigong, the implementation of the RADIUS results had contributed to the strengthening of the leadership of the earthquake management system of the government.

In some cases, cities might have to look for outside assistance for their action planning and implementation. Cities may have to hire consultants to facilitate the action planning process or to help assess options and costs for specific actions. Assistance by outside consultants should not substitute for stakeholder-based city planning, although they can greatly expand and deepen awareness of sources of disaster risk reduction and opportunities for climate change adaptation. External consultants can compensate for shortfalls of city expertise. However, most consultants come with a price tag and cities have to deal with funding issues again. One option would be for cities to search for consultants who can provide pro bono assistance. The academe can be one source of free consultants. It would be best if the city can tie up with an academic institution, such as a university, that is also based within the city. This will ensure minimal transportation costs for the consultants and shorter period to learn the conditions of the city compared to working with outsiders. Enhancing a city's climate disaster resilience will not happen by chance. A deep commitment from the city government and other stakeholders is needed to perform action planning and implement the resulting action plan.

Several challenges will have to be surpassed along the way, so perseverance and a strong desire for public service are in order.

CONCLUSION

A Climate Action Plan is the city's roadmap for action, orchestrating a diverse blend of city officials, NGO volunteers, members of the academe, donor agencies, and other stakeholders to work together on building the city's climate disaster resilience. As leading climate scientists say with increasing urgency that we have very little time left before climate change pushes the earth's life-support systems past critical tipping points, increasing numbers of cities have started or will soon start their own Climate Action Plan and will be looking for guidance on how to embark on this process. This chapter addresses this need. It outlines some steps for creating effective Climate Action Plans as well as highlights some of the main challenges that cities are likely to face along the way. Finally, it should be remembered that the action plan is only as good as its implementation. Action planning for city climate disaster resilience is very much like sailing. The city starts from currently where it is, charts a course to a destination, sails toward the goal, checks its progress occasionally, and makes course corrections en route. Success in making cities safer does not come by accident. It requires resilience mapping followed by action planning and implementation of specific projects and programs in the short, medium, and long term. Hopefully this chapter is helpful in providing useful details of the action planning process, which can be easily replicated by any city. The process of Climate Action Plan itself is a valuable learning opportunity for everyone who gets involved in it. The resulting intracity and intercity collaborations from the action planning process are essential for the exchange of knowledge and lessons learned.

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CHAPTER 9

FROM ACTION PLANNING TO COMMUNITY-BASED ADAPTATION

Sunil Parashar, Anshu Sharma and Rajib Shaw

INTRODUCTION

Urbanization is increasing the vulnerability in mega cities, where poor community often squat on low-lying areas, hilly areas, and hazards prone areas (IDNDR, 1999). The built infrastructures and systems are subjected to natural hazards: floods, earthquakes, landslides, cyclones etc. Thus, cities are vulnerable to disasters (IDNDR, 1999). Moreover, cities are also facing environmental risks due to increasing urbanization (Bhatt, Gupta, & Sharma, 1999). The vulnerability can be reduced by incorporating risk management into urban planning (Bhatt et al., 1999). The risk management includes risk analysis, prevention, and preparedness. Traditionally, risk management was seen as separate discipline to mainstream urban planning (Bhatt et al., 1999). The traditional urban planning is often good at making plans (city beautiful plans, land use plans, strategic plans, development plans) and regulatory controls (Hamdi & Goethert, 1997). However, they fail to deliver benefit at the ground. Only few benefits reach the poor, who are often considered as the most vulnerable in the cities. The urban planning can be improved with an alternative: action planning, which is "problem driven, community based, participatory, small in scale, fast, and

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incremental, with result that is tangible, immediate, and sustainable'' (Hamdi & Goethert, 1997). The action planning is often considered relevant in scaling up its outcome from local level to sectoral and national level. This chapter focuses on linking action planning and community-based adaptation. The community can be defined as ''a group of people that are directly linked to each other through a common identity, activity or interest'' (Jones & Rehman, 2007). The adaptation here is used in context of climate change, which is already happening, and impacts are growing (IPCC, 2001). The community-based adaptation is process oriented and ''based on communities' priorities, needs, knowledge, and capacities, which should empower people to plan for and cope with the impact of climate change'' (Reid et al., 2009). This chapter first briefly discusses the action planning process and its challenges. Further, the chapter discusses the action planning in detail. Later the chapter focuses on framework and tools for community-based adaptation. It also discusses few case studies and challenges and issues. Finally, the chapter tries to build a link between action planning and community-based adaptation.

ACTION PLANNING PROCESS AND CHALLENGES

The action planning aims at introducing risk management measures in urban planning through community participation (Bhatt et al., 1999). The action plan focuses on three important aspects: physical improvement, strengthening of community structures, and the identification of community-led environmental improvement initiatives (Bhatt et al., 1999). The community-led action plan includes various stakeholders: community, non-government organizations (NGOs), and government departments. The process of action planning involves problem identification, identification of viable solutions, selection of those solutions, appointment of task forces, and initiation of immediate steps (Bhatt et al., 1999). Similar approach toward action planning is coined in a book: *Action Planning for Cities* (Hamdi & Goethert, 1997). The entire exercise of action planning involves creative thinking. The section here discusses the action planning process in brief. The first step includes problem identification and prioritization of problem based on the consensus building among the community. The next step is to identify the feasible solutions to identified and prioritized problem with the support from facilitators. Further, the step is to make the selection of the solutions based on the urgency of task and that they can be carried out by the community itself with the resources available. Finally, the step is to identify the task force to

implement those solutions, implementing through partnership with local government and other agencies. One of the examples of action planning for risk management is the RADIUS initiative by International Decade for Natural Disaster Reduction (IDNDR) in 1996 (IDNDR, 1999). It aimed at promoting the activities to reduce seismic disasters in urban areas in developing countries. In the RADIUS initiative, the action planning addressed three stages of disasters: predisaster, during disaster, and postdisaster scenario (IDNDR, 1999).

Moreover, action planning can also address situations larger than local level. The experience from the practitioners of action planning shows that the action plans need not merely serve at local level, they can also be useful for overall strategic planning (Bhatt et al., 1999). Thus, the outcome of the action planning can be scaled up from local level to national level. Apart from its strength, action planning also experiences some challenges. There are challenges like bringing community representatives together with different views and opinion (Bhatt et al., 1999). The tradition barrier within society like sociocultural barrier is difficult to break without friendly approach of action planning. Moreover, few underlying concern are "how to carry over the process into implementation, how to avoid excessive dependency on the outsiders, how to avoid highjacking by professionals, how to assure continuity, and how to expand and learn from the pilot project" (Hamdi & Goethert, 1997). The following section shows an example of action planning, which was developed for community development (Hamdi & Goethert, 1997). It further explains all phases of action planning and demonstrates a process-based approach for problem solving.

COMMUNITY ACTION PLANNING

Community action planning aims at community development through problem solving (Hamdi & Goethert, 1997). It considers problems that are actual and perceived. To solve the problem, the tool helps communities to rank their problem as per priority based upon available resources. The key elements of community action plan are as follows: rapid, intense, field-based workshop, which is carried over 2–5 days; output that includes list of prioritized problems, options, and strategies; a community-based approach involving local community, technical officers from various departments and community representatives; transparent process; and focus on shared relation and implementation (Hamdi & Goethert, 1997). The workshop is usually organized once every year so that it supports implementation

interval. The exercise is very cost effective and involves materials like markers, sheets of papers, wrapping paper, cardboards, and unfold boxes (Hamdi & Goethert, 1997). It is highly recommended to organize workshop within the community. The community action planning includes four phases (Fig. 1).

The process starts with identification of problems, based on real as well as on those perceived by the local community. The second phase involves working on strategies, options, and trade-offs to solve the problem. The third phase focuses on implementation of the solution, mainly focusing on who will do what. Finally, the last stage looks at the monitoring side and sees whether implementation is smooth and addressing the problems. The following section discusses different phases in details.

Problem Identification and Prioritization

The first stage aims at identifying problems and prioritizes them. Community as well as stakeholders play key role. It involves different stakeholders like professionals, scientific groups, and local people. The

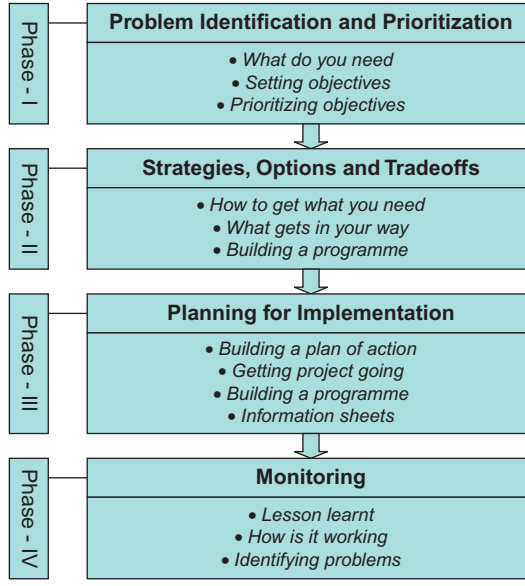

Fig. 1. Phases of Community Action Planning.

stakeholders' roles become more important when the community starts identifying its problems and prioritizing them. They help local community in this process. Identifying problems is quite complex issue because there are issues related to social, physical, cultural, political, environmental, and economic context that increase the risks. Thus, it is essential to start from micro-level because the above-mentioned risks are interlinked at individual level (Hamdi & Goethert, 1997). At the micro-level, the problems and constraints are identified by local people based on their skills, education, and local knowledge. The common problems and needs of the community are identified with the help of different methods. These methods are more or less participatory appraisal techniques, which give platform for action planning (Bhatt et al., 1999). For example, direct observation that helps stakeholders as well as community to understand the area and enable them to develop an opinion about how things work. Similarly, semi-structured interviews (SSIs) can be used to understand why things work in the manner that is observed. Listening to the needs and problems of women, children, elders, and other key informants will help in understanding the causes of the problem. Moreover, measuring and counting can also be used for problem identification and prioritization (Hamdi & Goethert, 1997). For example, measuring land utilization, densities, acceptable distance to standpipes, nearby clinic, school, land value of greatest commercial areas, land utilization percentages, other indicators of wealth etc. The prioritization of the problems is done on the basis of "now," "sooner," and "later" (Hamdi & Goethert, 1997). The prioritizing part also involves stakeholders like experts with the knowledge of risk management. They can ensure whether the selected priorities would be wise choices for interventions and would not increase future vulnerability. Further, the assessment can be done on what community can do individually and in what case it would need help from other stakeholders. This will help in setting the objectives and prioritizing them. There are other methods like diagramming, mapping and modeling, and conducting games/role play and group work that can be done to identify problem and opportunity (Hamdi & Goethert, 1997).

Strategies, Options, and Trade-offs

The second stage focuses on what type of actions or approaches are suitable to deal with the problem. The aim of this exercise is to select solutions that can be taken up on the prioritization basis and that can be implemented by the community itself (Bhatt et al., 1999). There are strategies, options, and

trade-offs that have to be properly analyzed to reach the suitable actions (Hamdi & Goethert, 1997). There are various operations that can be used here. For example, brainstorming in mix group is a good way to explore different ways to solve the problems. The aim of this particular exercise is to generate ideas, discover alternatives, and solicit response from others. Similarly, diagramming can also be used to understand the suitable actions and approaches to deal with the problem. It involves making seasonal calendars, time lines, daily routines, and pie charts. Local people play an important role in diagramming. The diagrams are very essential in understanding the structure and work schedule. Similarly, mapping and modeling is the participatory way to decide suitable actions and approaches. Mapping and modeling involves social maps where all stakeholders record their perceptions, feelings, sentiments, prejudices, wants, needs etc. It also includes urban topography maps on which deficiencies related to infrastructure and utility services can be recorded. Mapping will help in allocating resources and trade-offs to deal with. Another way to find suitable ways for actions and approach is to conduct games and role play, which aims at building awareness among stakeholders about the key issues. It involves listening to the need of those people who did not participate in the planning phase. The above operations will help in building a program and identifying proposal according to people's need. Further, these operations will also help in identifying the constraints and review sequence of proposal (Hamdi & Goethert, 1997).

Planning and Implementation

This phase focuses on building a plan of action, building a program, and identifying the project teams and immediate tasks. This stage involves questions like "who does what," "when," and "how," and "how to get it going." Here questions like "who does what" can be resolved by the available resources, including human and financial resources. The questions related to "when" and "how" can be addressed in projects tasks by incorporating operations like prioritizing, diagramming, and group work (Hamdi & Goethert, 1997). For example, group work is about intermixing of genders, age groups, experts with community people, and managers with technical staff. These types of intermixing of different groups expose participants to a wide range of interest and demand, and builds cooperation. Similarly, how to get things going is based on preparation for implementation and resources. Listing the project tasks is also essential in planning and

implementation. Prioritizing, diagramming, and conducting group work is important when generating project tasks.

Monitoring

This stage is related to how well a project is working and what can we learn from that. It allows monitoring problems midcourse, and suggesting corrections. Monitoring can be done through direct observation, interviews, measurements, prioritization, and group work. Monitoring aims at knowing the impact of work or program. For example, assessing whether the program or project achieves its objectives at the local level. As well as assessing the value of the method used – the aim is to learn and to know what impact the project is likely to have at the city level. There are various indicators for monitoring the program and project (Hamdi & Goethert, 1997; Beaudoux, de Crombrugghe, Douxchamps, Guenuea, & Nieuwkert, 1992). For example, some of them are technical indicators, economic indicators, operational or organizational indicators, social indicators, and environmental indicators. The technical indicators include measures that assess program on quantitative and qualitative basis. How improved roads have led to decrease in flooding and improved access for vehicles. Is the water supply inadequate? Whether new standpipes reduced the walking distance? Similarly, economic indicators can be used to judge the cost-effectiveness of the program and improved level of earnings due to employment program, and can also be compared with technical indicators. Likewise, operational and organizational indicators show the functionality and effectiveness during the project delivery. In the same way, social indicators reflect assessment of minority groups who are excluded from taking advantage of loan and schemes. Finally, environmental indicators will show the impact of intervention on the environment.

COMMUNITY-BASED ADAPTATION

"It is clear among the scientist that climate change is happening due to the emissions of greenhouse gases produced largely by industrialized countries" (Reid et al., 2009; IPCC, 2007). The worst affected will be the poor and marginalized communities from world's poor countries. Critically, these communities contributed least to climate change, mainly due low greenhouse emissions, but will suffer most from the consequences. Even if the emission

of gases is reduced, the climate change will happen (Reid et al., 2009). The industrialized countries have taken responsibility to help poor community to adapt to climate change. Until now, most of the adaptation measures in the nonindustrialized countries are focused on national planning and top-down approaches. These approaches are based on climate modeling. Little attention is paid to communities' coping experiences and efforts to changing environment.

The community-based adaptation is a process that recognizes the ability of the communities to respond to climate change and is a key determinant of adaptation (Jones & Rehman, 2007). It is a community-led process, "based on communities' priorities, needs, knowledge, and capacities, which should empower people to plan for and cope with the impact of climate change" (Reid et al., 2009). The term adaptation is defined as "a process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity" (Smith & Wandel, 2006). It is clear from the above definition that adaptation also focuses on risk management, which is similar to what action planning tries to do. Thus, community-based adaptation and action planning both focus on risk management. However, action planning further tries to introduce risk management into urban planning (Bhatt et al., 1999).

The following section discuses the framework, which is process oriented and adopted to address climate change (Mercer, Elman, Suchet-Pearson, & Lloyd, 2009). The framework involves four steps: (1) community engagement, (2) identification of vulnerability factors, (3) identification of indigenous and scientific strategies for vulnerability reduction, and (4) integrated strategy (Fig. 2). These four steps are derived after guided discovery process where field work methods are used to help community to draw on past experience and knowledge, and which help in generating ideas and connections that help in taking actions. At many times, communities themselves mention climate change is a challenge. This section discusses four steps in detail.

Community Engagement

Community engagement is collaboration between community and stakeholders. The aim of this type of engagement is to help or support communities to identify their goals, interest, and needs. The engagement also supports report building and trust with local community. The step involves using various participatory tools, like mapping, time lines, and

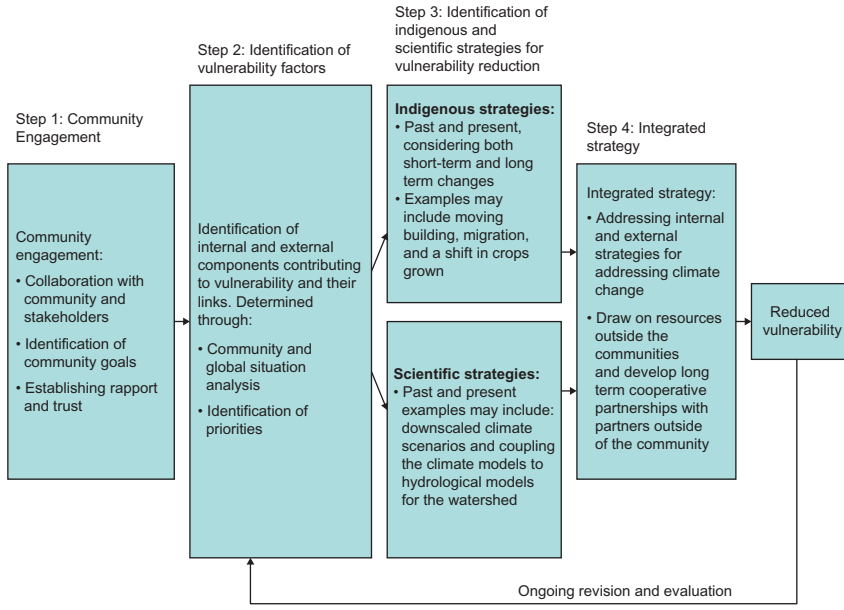

Fig. 2. Revised Process Framework for Introducing and Addressing Climate Change. *Source:* Mercer et al. (2009).

matrix ranking, which help stakeholders to carry out group sessions with different age groups in the community. The group session facilitates the creation of the historical profile of the area, hazards, event time lines, and maps. The community also gives its opinion about the climate change, whether it is a challenge or not. The scientific evidence gives support to community in decision making.

Identification of Vulnerability Factors

The internal and external components or factors and their linkages contribute to vulnerability. Internal component factors include those that can be controlled by the community, such as cropping pattern and crops, and external factors include those factors that are beyond the control of the community, such as floods, cyclones, and storms. The situational analysis is used to show impact and vulnerability due to global climate change. For example, the satellite observations and downscaling climate projections for

short- and long-term scenarios are used in discussion to link climate change to internal component factors, which increases vulnerability.

Identification of Indigenous and Scientific Strategies for Vulnerability Reduction

The third step deals with identifying indigenous strategies for vulnerability reduction for environmental hazards and climate change. Indigenous knowledge mainly deals with how people in the past have responded to longer-term change and to use past experience that might be applicable under current local reality. For example, to build houses on stilts to avoid flooding or to construct steeply sloped roofs to avoid fire risk from volcanic ash and to ensure heavy runoff during rainfall. Identification of scientific strategies includes information that can be useful for the community. For instance, deciding on which crop to plant under expected condition.

Integrated Strategy

Integrated strategy involves bringing together internal and external strategies for addressing impact of climate change. It is developed from resources utilized from outside the communities and further facilitates partnerships with partners. These partners incorporate external scientific knowledge about climatology and ecology.

TOOLS FOR COMMUNITY-BASED ADAPTATION

This section discusses in detail the wide range of tools that are used in the community-based adaptation process (Table 1). These tools operate at community level and can be applied in any community (Jones & Rehman, 2007). The aim is to enhance the ability of the community to have wider range of choice in the future (Jones & Rehman, 2007).

Seasonal Calendar

Seasonal calendar is widely used to understand the way in which communities deal with or react to hazards. The tool is also useful in

Table 1. Tools Used for Community-Based Adaptation and Their Characteristics.

Tools	Characteristics
Seasonal calendar	• Reliant on local knowledge, illustrates important activities, problems, or resource changes throughout the calendar year. • The tool is useful in investigating community-based activities, livestock production, cropping and cultivation, weather and climatic conditions, and expenditure and borrowing.
Time line	• The tool is used to highlight the trends and key points in the history of the community or village that local people consider had an impact on their livelihood – positive or negative. • The tool forms a basis upon which problem identification and option assessment are made while making community action plan.
Transect walk	• The tool is useful in showing the range of different problems, conditions, and opportunities in the target area. • It provides specific information in the form of map. It adds details on specific information (slope drainage, vegetation, water, soils, and other resources).
Community mapping and modeling	• These techniques are pictorial or symbolic representation of information. They are community sketch maps: social maps, physical and resources maps, and topical maps. • The community maps are used in defining micro-zones, differences in land use, and area where particular problems are prevalent. They are also used to lay the transect route.
Ranking and scoring	• It is used in prioritizing community problems and alternative solutions. It generates reasons why community chooses one item over the other. • The tool is useful in arranging community's problems, solutions, and technical inputs based on interest of the users.
Semi-structured interviews (SSIs)	• They are used to get the information about the society from individual informant. The key informant interview is used to get the specialized information about the community. • The SSIs also include group interviews, direct observation, and secondary sources.

investigating community-based activities, livestock production, cropping and cultivation, weather and climatic conditions, and expenditure and borrowing (Adebo, 2000). It aims at capturing the relationship between seasonal cycle and their impact on human activities (Vulnerability and Capacity Assessment, 1996). The seasonal calendar shows the change in the distribution of rainfall, agriculture, labor, food consumption, diet, animal

fodder, sickness, labor migration, income, expenditure, and debt across different seasons. Instruments mainly required are stones, leafs, seeds, and sticks. The tool is reliant on local knowledge and illustrates important activities, problems, or resource changes throughout the calendar year (Adebo, 2000). It is less expensive but takes more time to do. The tool facilitates group discussion as well as interviews and asks members to create a calendar. The local people use their local knowledge and experience to show the cause and effect of the particular event. For example, they start with climate, then crops, then labor demand, and so on. Later, they also explain how they dealt with situations.

Time Line

It is a participatory tool that aims at understanding or visualizing the human experience of disasters in the past. The tool is also useful in highlighting the trends and key points in the history of the community or village that local people consider had an impact on their livelihood – positive or negative (Adebo, 2000). In this exercise, local people are asked to recollect or think about past events. For example, change in land use, customs, population events, and availability of services. The local people are asked to record events on a slip of paper. After that, slips are placed in a chronological order and periods are identified where nothing happened. Finally, the last part of this exercise is group discussion where local people as well as the other stakeholders try to understand the local people experience, like how did they deal with those events? How much things have changed? Generally, the time period can start with any historical event, like Independence Day etc. Many practitioners consider this tool as ''ice breaker'' (Vulnerability and Capacity Assessment, 1996). The tool can also be used for setting up a basis upon which problem identification and option assessment can be made, while making community action plans (Adebo, 2000).

Transect Walk

It is a process where outsiders or stakeholders walk with local people to explore problem within the community. It involves observing land, vegetation, livestock etc. and listening about the problems, especially past experience of any disasters and how community well responded to the situation (Vulnerability and Capacity Assessment, 1996). The process of transect walk involves traversing area from north to south and from highest

to lowest point. Observation, discussion, and recording are the most important aspects of the transect walk. Finally, transect output provides maps that distinguish micro-zones or units like slope and level terrain, land use units, and the area that is affected by stresses, erosion, and proneness. Further, the current transect map can also be used to make historical transect map based on the knowledge of older residents who know how the situation was 10–20 years back.

Community Mapping and Modeling

The aim of this exercise is to classify and form relationship between topography, natural resources, human settlements, and activities (Vulnerability and Capacity Assessment, 1996). It also identifies the problems and possible solutions. The process involves making maps and models. The techniques are pictorial or symbolic representation of information. They are community sketch maps: social maps, physical and resources maps, and topical maps (Adebo, 2000). The local community plays a key role here and is involved in making these maps by using local materials, such as seeds and stones. These maps show natural resources, topography, human settlements, and utilities. Similarly, the social maps show social structure of the area or urban neighborhood and also give information about the infrastructure like utilities, roads, and social situations. These maps are important in defining micro-zones, differences in land use, and areas where particular problems are prevalent (Adebo, 2000). They also help in defining the transect route. Later, these map can be used for key discussions, analysis, and planning.

Ranking and Scoring

This technique is widely used to prioritize community's problems and alternative solutions. There are different types of ranking and scoring used: preference ranking, pairewise ranking, direct matrix ranking, and direct matrix scoring (Adebo, 2000). Preference ranking can be used in getting idea of what community thinks are the priority problems and preferences. Pairewise raking is used to compare items and why community prefers one possibility over another. The choice of items can be between crop varieties, water points, food diets, livestock species, problems, solutions, and different issues. Direct matrix ranking is utilized to do comparison. Items are compared on horizontal axis and criteria vertical lines to rank choices. The choices range from most important to least important (i.e., 1st, 2nd, 3rd etc.).

Direct matrix scoring is utilized to compare items against each criteria mentioned before a choice. The ranking and scoring can be done with individuals, households, and community members. It also depends upon the issues to be ranked or prioritized. The exercise is also useful for developing community action plans, which are based upon communities' preferences (Adebo, 2000).

Semi-Structured Interviews

SSIs are not prewritten questionnaires but mainly open-ended questions. The tool is widely used in "ground truthing" (Vulnerability and Capacity Assessment, 1996). The people who come for interviews are unfamiliar with the area. The SSIs allow discussion to be made in effective manner. They include group interviews, community interviews, focus group interviews, key informant interviews, and interview chains (Vulnerability and Capacity Assessment, 1996). The group interviews are conducted with special groups of people (on the basis of gender, age, jobs etc.). The community interviews are focused on all of the residents of village or urban neighborhood. The key informant interviews are conducted with people with special information. The interview chain involves different interviews with various people involved in different stages of process (e.g., production, marketing etc.). The person selected for interview should feel comfortable with respect to time and space. The questions need to focus on key problems that lead to key issues.

CHALLENGES AND ISSUES OF COMMUNITY-BASED ADAPTATION

This section focuses on the key issues as well as challenges for community-based adaptation to climate change (Fig. 3). It also discusses the key factors that influence community-based adaptation.

Knowledge

The community-based adaptation incorporates both climate data and local information. The climate data are predicted from models that are mainly based on geographic resolution and timescale (Reid et al., 2009). The model can predict climate vulnerability of geographical area at broad level.

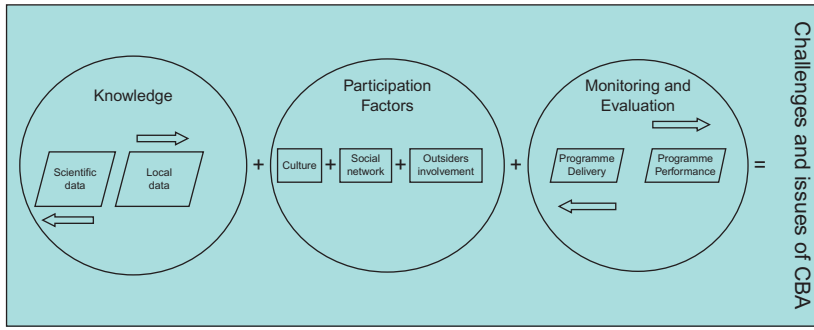

Fig. 3. Challenges and Issues of Community-Based Adaptation.

At many instances, the information from scientific data and local data do not match (Fig. 3). Therefore, better models are needed that can predict local area condition or vulnerability to climate change. The scientific data are of no use if not utilized properly. The weather data are generally available in the form of mean annual temperature and precipitation change. But, these data are of no use to the farmers because they do not tell the timing of rain and intraseason rainfall pattern. Similarly, there are issues related to trust of farmer toward the scientific data. However, local tools used by farmers are not always reliable. Therefore, it is very important to validate local data with scientific data. Trusting only on one source is not suitable because the local tools are not always effective, especially for climate change.

Participation

The degree of participation is very essential in community-based adaptation. The entire process is participatory in nature, and therefore, participation affects the sustainability and outcome of the process (Reid et al., 2009). Sometimes outsiders' dependency influences the process of community-based adaptation (Fig. 3). The priority of the local community gets influenced if dependency of the local people on outsiders is very high (Hamdi & Goethert, 1997). The experiences from the field have shown that adaptation is effective and sustainable if it is built on local knowledge, experience, and putting the community in the driving seat. On many occasions, professionals who come from the outside get engaged in conflicts due to their behavior, attitudes, and mindset, and because the

institutional culture does not match with their role. It is very important for scientists, planners, and communities to learn, analyze, and plan actions in partnership with local people. It is very essential for communities to take charge rather than doing "to community." Sometimes the community does not see climate change as priority and foreign funds for adaptation do not match the priority raised by the community. There are different types of participations in community-based adaptation (Reid et al., 2009). They are passive participation, participation in information giving, participation by consultation, participation for maternal incentives, functional participation, interactive participation, and self-mobilization (Reid et al., 2009). The passive participation is like a unilateral announcement, where people's voices are ignored and the scope of information sharing flows between professionals. The participation is merely to provide information to the details posed by researchers. People are unable to influence the proceedings because the output of the research is not shared or checked for the accuracy. Participation by consultation is like giving information to the outsiders. People's views are heard but outsiders define the problem and do not share the decision. The outsiders have no obligation to take into account local people views or opinion. Participation for material incentives is giving information or resources to the outsiders in return for food, cash, or other incentives. The local people have no role in further activities when incentives end. At many times, participation is functional, when the role of local people is to participate by forming groups to meet the already made objectives related to the project. The involvement of the local people comes after the major decisions are made. The interactive participation is a process where all stakeholders or participants, including local people, get engaged in joint analysis and create action plans. The course of action is very interactive in nature and makes use of systematic and structured learning process. The local people also have stake in maintaining the structure. Self-mobilization is an independent initiative by local people where they contact with outsiders for information gathering or advices. They only control on how resources need to be used. The self-initiative action or approach may or may not challenge existing inequitable distribution of wealth and power.

Monitoring and Evaluation

Monitoring and evaluation of community-based adaptation practices is very important for feedback and for further improvement. However, there are

challenges associated with evaluation of activities. A good community adaptation is participatory in nature and decision making is mainly done at the community level. Therefore, evaluating the performance of the decisions is very difficult for funding organizations that are responsible for measuring the effectiveness of the process (Reid et al., 2009). ''Any move towards centralized tracking and evaluating system must ensure not to lose sight of the need to facilitate genuine participatory processes that empower communities to adapt to climate change in ways which address locally identified priorities'' (Reid et al., 2009).

Outsiders' Involvement

Sometimes common interest gets influenced due to the presence of high officials. The view of the local community then becomes ''subordinate view,'' which affects outcome of the community-based adaptation practices (Hamdi & Goethert, 1997). The outsiders' involvement often creates a type of dependency of the local people on them, which affects participation of the local people. The local people start expecting solutions or results from the outsiders. Thus, greater the outsiders' involvement, less will be the actual participation from the local people, which will affect the outcome of the program. Fig. 3 shows the challenge of community-based adaptation, where outsiders' involvement is increasing. Therefore, participation is very essential in setting the framework for community-based adaptation. The community-based adaptation is incomplete without local people participation. The involvement of the local people is very important in initiating, planning, designing, implementing, and maintaining the program.

Social Network

Social network plays an important role in the process of community-based adaptation. There are places where social network builds relationship between different actors, such as schools, political parties, associations, welfare groups, and others. These kinds of relationships determine household knowledge about climate change and adaptation options (Ensor & Berger, 2009). Social network is also important in bringing new ideas and knowledge about climate change in the community. Agencies like NGOs and community-based organizations (CBOs) not only enhance the knowledge of the community but also help in building networks with outsiders. A good

social network also supports increased participation of the local community in adaptation strategy. This kind of networking is also helpful in bringing the local experience and lessons of adaptation that become the guiding principle while making community adaptation strategy.

Culture

The cultural aspect is important in implementing the adaptation process. In any society, culture has a strong relationship with individual or community well being. The decisions or goals of individuals are not only decided from the objective but also influenced by the cultural factor. ''Freedom of choice is dependent on social practices, cultural meaning and a share language – the context of individual choice is the range of option passed down to us by our culture'' (Ensor & Berger, 2009). It is this cultural dominance that views adaptation to climate change as very essential or not important. However, sometimes community becomes reluctant to participate in community-based adaptation process. For example, sometimes different livelihood options are provided to the women as an adaptation measure but from cultural perspective women are not allowed to work outside. Therefore, it is very important to consider the cultural factor in the process of community-based adaptation. Considering culture is also important to help in understanding the power relationship within the society and provide an entry point into the community.

ACTION PLANNING TO COMMUNITY-BASED ADAPTATION

Community-based adaptation is process oriented and therefore needs a process-based approach. The aim of community-based adaptation is to improve the ability of the community to cope well with the impact of climate change. Thus, it is a community-driven risk management process to deal with the impact of climate change. The tools and methods used in community-based adaptation are participatory in nature and similar to Participatory Rapid Appraisal (PRA) tools, which are also used in action planning process for urban risk management. The main strength of Community-based adaptation process lies in the approach, which is community-led, local knowledge, and effective at local level. In spite of its

Table 2. Similarities between Community-Based Adaptation and Action Planning.

Criteria	Community-Based Adaptation	Action Planning
Community based	√	√
Bottom-up approach	√	√
Risk management or reduction	√	√
Local level	√	√

Note: Symbol "√" means yes.

strength, the scope is only up to local level and there are issues and challenges with this approach. For example, the effectiveness of community-based adaptation depends upon how well the steps are executed in the community. The practitioners often face challenges due to unavailability of scientific data, ineffective participation, and lack of monitoring and evaluation (discussed in the earlier section). However, the scope can be further improved with the help from action planning, which is also community-led initiative for risk management. The common similarities between community-based adaptation and action planning can become a platform for their integration (Table 2).

They both rely on bottom-up approach for solving the problem. Both of them use PRAs tools and techniques in their approach. Finally, the focus of community-based adaptation and action planning is also on risk management or reduction. Hence, introducing community-based adaptation into action planning will improve its scope and overcome few challenges. The action planning can further help in introducing community-based adaptation into urban planning.

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CHAPTER 10

CAPACITY DEVELOPMENT AND TRAINING: BLENDED LEARNING PROGRAM

Eiko Wataya

CAPACITY DEVELOPMENT AND TRAINING

The Need for Capacity Development

Capacity development (or capacity building, capacity enhancement) is becoming an increasingly important component in development assistance through agreements among multilateral and bilateral donors and developing countries because it is critical for achieving development objectives. Much evidence has indicated that development assistance and projects have not been successful due to capacity constraints; therefore, many training programs for capacity development were implemented and continue to be in demand at various levels.

The definitions of capacity development are very broad. For example, OECD (Glossary of Statistical Terms, accessed June 2010) defines it as the "means by which skills, experience, technical and management capacity are developed within an organizational structure (contractors, consultants or contracting agencies) often through the provision of technical assistance, short/long-term training, and special inputs (e.g., computer systems). The process may involve the development of human, material and financial

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resources.'' Meanwhile, the United Nations Development Programme (UNDP, 2004) defines capacity development as ''the process through which individuals, organizations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time.'' JICA (2006) defines it as ''the ongoing process of enhancing the problem-solving abilities of developing countries by taking into account all the factors at the individual, organizational and societal levels.'' According to the World Bank (2009) ''capacity development is a locally driven process of learning by leaders, coalitions and other agents in socio-political, policy-related, and organizational factors to enhance local ownership for and the effectiveness and efficiency of efforts to achieve a development goal.'' However, despite the different definitions among such organizations, the general consensus is that capacity development aims to improve the capacity of people through training and other educational opportunities/methods in order to enable individuals, organizations, institutions, and society to support challenges in development. In this regard, capacity development can be measured by determining how effectively and efficiently individuals, organizations, and societal groups mobilize and use resources to define and achieve their respective development objectives.

Such diverse definitions further suggest the paradigm shift of objectives of training, such as moving from skills transfer exclusively from experts to the integration of practical and action-oriented aspects in the trainings to enable learners to apply them in their own context to improve their situations. These definitions further emphasize that knowledge dissemination and experience-sharing from different sources are important. Sharing problems and issues with people in different places but in similar circumstances is an effective way to identify practical solutions. These points suggest that the training for capacity development becomes more focused on learner-centered and action-oriented programs at different target levels required for training, such as individual, organizational, and societal. For capacity development to have sustainable results, strengthening stakeholder ownership, the efficiency of policy instruments, and the effectiveness of organizational arrangement are critical.

As is evident from past experiences, natural disasters (i.e., climate-induced disasters) are a major risk factor in people's lives. In the urban context, such disasters not only affect human lives but also cause serious damage to economic and industrial endeavors that may lead to damage of the national interest. To prepare and mitigate damage from disasters, (large-scale) infrastructure (construction-led) projects are required to the extent necessary. However, this requires a huge budget, which means it is not sustainable to continue such approaches, especially for countries whose economy is in

development. More importantly, the exclusively construction-led approach is almost impossible to use to overcome all kinds of vulnerabilities of cities and mitigate all possible risks in the event of disasters. It is rather feasible and sustainable if key players and stakeholders in cities can evaluate their vulnerabilities, inherited risks, and assents in their own contexts and create the most suitable plans (countermeasures) for implementation for disaster risk management.

Under the Climate and Disaster Resilience Initiative (CDRI) umbrella, one of the training programs for capacity development actually focused on materializing these aspects. CDRI Capacity-building Program will be discussed in detail in a later section, but the program is very much in line with recent movements – namely, resilience rather than resistance that focuses on strengthening the urban system to cope with the climate-induced disasters as well as on shifting disaster risk management from emergency to risk management (i.e., from the postdisaster to the predisaster stage). An increased number of people and specialists who are able to contribute to disaster risk management at the different levels of activities are required. For the program, it is important to involve local government officials as a key player since past experiences with disasters have shown that local governments are the first respondents from within the government, and they are geographically close to the local communities. Thus, it is vitally important to undertake integrated disaster risk reduction approaches and disaster risk management at the local level in order to maximize effective action. Therefore, the program is designed for local government officials and is expected to integrate synergy such as a cross-sectoral/intergovernmental relation (holistic) and local government activities vertically linked to national government (vertical) into a program implementation stage.

Disaster risk management involves various stakeholders with different areas of interest and prioritized objectives; as such, it tends to be very difficult not only to capture the right level of participants but also to design and offer the training course. The CDRI Capacity-building Program is very unique in terms of including both policy makers and engineering experts who will be able to contribute their engineering viewpoints. In this regard, this type of program can be classified as organizational capacity-building aimed at general improvement of disaster risk management in local governments to perform essential functions, identify and solve issues (problems), and set and achieve goals. The program could also offer opportunities for those people to explore how to link their internalized, inherent degree of vulnerability or resilience, experiences, and skills to higher level of activities. In light of the need for capacity development and its paradigm shift of training objectives

that also relate to disaster risk management, this chapter will examine some benefits and advantages for applying the distance learning method to capacity development programs as well as verify some key points of program design and implementation by using a case study as an example.

Capacity Development through Distance Learning

Information and Communication Technology (ICT) has become more accessible to the public and more attractive for people who want to gain information and knowledge about events happening in other parts of the world without being blocked by distance and time. It shows great progress in the use of education and training to achieve development goals as well as offering learning opportunities to previously excluded people by reducing costs.

Training programs are typically offered in face-to-face (F2F) classroom-type setting; the maximum number of people involved is determined by topic, budget, location, and space availability. This is still a very important method for conducting training, but if there is a need to train more people, the program needs to be delivered repeatedly to expand its outreach. If ICT is used in training, it allows us to deliver programs to more relevant people by obtaining more resources and knowledge/experiences from others in more time-flexible and cost-effective manners. The benefits of using ICT in training include enabling information and knowledge to travel faster and farther, supporting information and knowledge-sharing on a large scale, providing just-in-time information and knowledge, bringing about revolutionary advances in distance learning, and significantly reducing learning costs (Maguire & Zhang, 2007). Indeed, ICT has changed the way in which communications, learning, activities, and business are conducted among people. Through the use of the Internet and widely dispersed educational/training resources (including learning tools, platform, core learning materials, training guide, reference, instructors, subject experts, and other learners), learners in different locations and time zones can be connected.

The use of ICT has been very effective and efficient for the CDRI. For institutional level of training, distance learning makes it possible to scale up learning to allow more people in the same organization or group to participate, share the same learning contents/experiences, and engage in knowledge-sharing experiences so that they can support each other and work as a team, acting together. In addition, as the training is an action-oriented program, it is very helpful for sharing the same learning experiences for creating a driving force within the same organization to change processes

and environments. It is also beneficial for participants to exchange their experiences and issues with participants in other locations. Such peer learning through the use of various ICT results in the creation of a link between learners in different locations that will serve as a seed for spill-over effects of the training program to change their situation beyond their organizational levels.

As learners are not limited to a single source of information during distance learning, the learning process has also evolved. Four types of learning processes occur (see Fig. 1) based on two variables that are used to identify the major features of these processes (i.e., exploration or dissemination), and two other variables used to identify the source of information (i.e., single or multiple) (Maguire & Zhang, 2007). By applying this matrix to the CDRI, the program can be categorized as a "collective exploration of knowledge and the seeking of truth and solutions"; that is, participants learn the process of exploring knowledge and seeking truth and solutions collectively. Thus, the learning process involves learning knowledge, collecting information, gaining an understanding of issues, and analyzing to reach consensus and create action plans among a learner group. It is important to design a technology platform and pedagogical scenario that fits with this type of learning process, target audiences, and learning objectives. This process also requires transferring

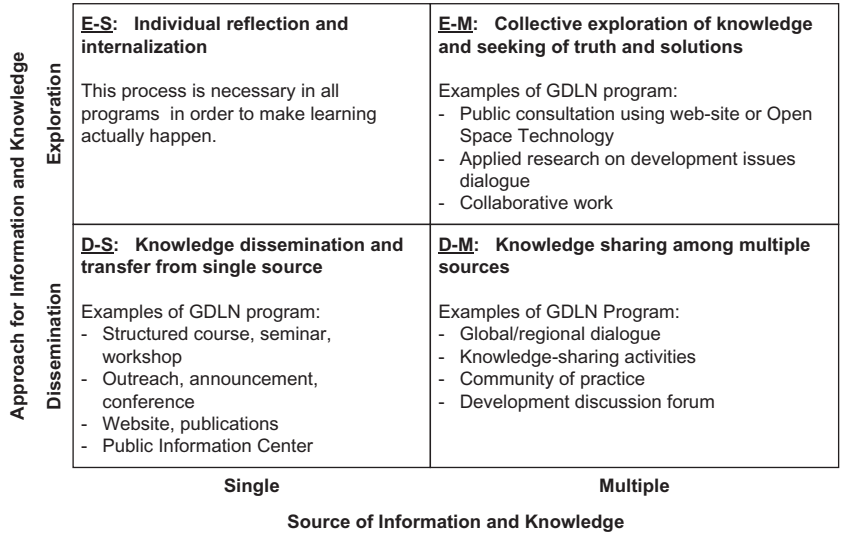

Fig. 1. Matrix of Types of Learning Processes. *Source:* Maguire & Zhang, 2007.

knowledge and skills to other people within and beyond each city's context for the further spread of a CDRI concept and practices. Distance learning used by ICT works effectively for these purposes.

Maguire and Zhang (2007) explained that "distance learning is an umbrella term encompassing all learning that takes place at locations remote from the point of instructions. It may also refer to training applications delivered by computer networks to participants or students at any network note. Web-based training is also included." They also explained the differences among distance learning, e-learning, and blended learning: "E-learning is also an umbrella term that covers all learning that takes place using electronic means, such as the computer, and that uses the Internet or storage devices such as CD-ROMs, DVDs or multimedia." This learning method is the most flexible in terms of time for learners and offers the most cost savings. Blended learning is closely related to distance learning and e-learning. According to the World Bank Global Development Learning Network (GDLN), "Blended learning refers to an educational experience created cost-effectively using a mix of integrated distance learning technologies as videoconferencing (VC), e-learning, videos, and CD-ROM. Typically the blend will also include traditional F2F classroom activities, print resources, and a variety of instructional strategies such action learning, participatory learning, interactivity, case studies and more" (GDLN Toolkit CD-ROM, 2005).

Blended learning differs from e-learning in that if offers the integration of F2F and/or VC, meaning participants will engage in human contact during the learning process. Many past experiences have demonstrated that the use of online interfaces in which all contents are already uploaded is not always a driving force for people to continue to learn. Without considering good core learning materials, an appropriate platform that people can easily access, open communication channels between resource persons/facilitators and participants, the creation of opportunities for learners and facilitators to get to know each other, and facilitator roles in the online platform, the program will not give the desired results. This is a very challenging part of designing and delivering programs, as demonstrated by the CDRI's program.

CDRI CAPACITY-BUILDING PROGRAM

Goals, Objectives, and Program Structure

CDRI Capacity-building Program with blended learning methods was designed and implemented from February to April 2010 in collaboration

with Kyoto University Graduate School of Global Environmental Studies, CITYNET, Tokyo Development Learning Center (TDLC), The World Bank, Socio-Economic-Educational-Development Service-India (SEEDS), UN International Strategy for Disaster Reduction (UN/ISDR), and the Asia Regional Task Force on Urban Risk Reduction (RTF-URR). The program helps city government officials become more aware and able to communicate more easily about current and potential future risks facing their cities. It further promotes the development of comprehensive plans to address these issues. In addition, distance learning methodologies used in the program ensure that local government officials are able to get continued support and feedback over the long term, using much more reasonable expenditures. Hence, the overall goals of this program are to motivate and enable city government officials to become aware of current and future potential risks of climate-related disasters and initiate the development and implementation of the Climate Action Plan (CAP) in their own contexts in order to build the resilience of their urban systems and communities.

Taking into consideration the needs for promoting Hyogo Framework for Action (HFA) implementation that will be customized for local governments, while enhancing and materializing urban communities' action planning process in an organized manner in order to increase the number of urban communities associated with future incidences of climate-induced disaster, a comprehensive action-oriented learning and training program was required. In this regard, the program package was divided into three stages with specific objectives (see Fig. 2).

- Stage 1: Capacity-building of city government officials, to complete a CDRI questionnaire for the creation of overall resilience mapping by

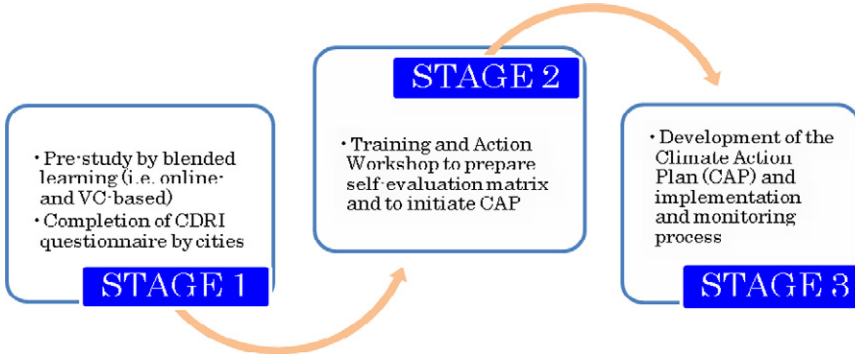

Fig. 2. Program Structure of CDRI Capacity-Building Program.

(i) learning the basic concept and methodology of CDRI (CDRI analysis), (ii) understanding how to fill out the CDRI questionnaire, and (iii) assigning tasks in order to complete the CDRI questionnaire by the end of Stage 1.

- Stage 2: Training and Action Workshop, to design a self-evaluation matrix and initiate CAP by (i) reviewing urban resilience, including development of measuring tools (i.e., CDRI), with the overall resilience mapping; (ii) coming up with measurable implementation measures (i.e., self-evaluation matrix); and (iii) discussing required actions within time frames through the demonstration of a methodological approach for facilitating the creation of the CAP.
- Stage 3: Initiating development of the CAP and implementation process by (i) examining policy formulation to be included in the CAP, (ii) incorporating decisive actions and a specific time frame into the CAP, and (iii) monitoring the process and evaluating actions taken by cities.

The program targeted city government officials (local government level) and urban ministry institute officials (national government level) of CTYNET member cities as well as respective countries. Focal points of each city were the heads of city/urban planning departments. With the aim to secure feasibility of each action plan and scale up the CDRI Capacity-building Program outreach, urban institutions were invited from the beginning of the program. Eight cities participated in the program: Chennai (India), Colombo (Sri Lanka), Dhaka (Bangladesh), Hue (Vietnam), Kuala Lumpur (Malaysia), Makati (including LCP Makati, Philippines), Sukabumi (Indonesia), and Suwon (Korea). In total, 57 people registered. The program started on February 8, 2010, and successfully ended on April 30, 2010. Among all those registered, 42 people accessed a learning management system (LMS) that was a core learning platform of the program and participated in VC sessions.

Learning Process and Tools

Multicountry blended learning, which uses a mix of learning technologies to bring about optimal learning outcomes in each stage, is the major methodology of this program. The major delivery mode of and tools to be used for the program varied according to the objectives of each stage (see Table 1).

The program is designed as a combination of synchronous mode and asynchronous mode. In order to support all the learning processes, an LMS

Table 1. Learning Process and Tools.

	Stage 1 →	Stage 2 →	Stage 3 →
Program agenda and components	Capacity-building of city government officials to complete CDRI questionnaire for overall resilience mapping 1. Core learning subjects a. Development, risk, and resilience b. Climate disaster resilience in cities c. Climate policy and action planning for cities (supported by explanatory videos and printable text) 2. Self-assessment 3. VC sessions (two times on "Methodology" and "Clarification") 4. CDRI questionnaire 5. References 6. E-mail group/discussion board	Training and Action Workshop to design self-evaluation matrix and to initiate climate action planning 1. Overall city resilience mapping 2. Self-evaluation matrix 3. Initiating climate action plan 4. Guidelines for making action plans (e.g., "Guide for Implementing HFA for Local Governments") 5. Presentation materials on instrumental subjects 6. Others	Initiating development and implementation of the CAP 1. Questionnaire for monitoring and evaluation 2. Reporting-related materials 3. Others
Learning modality	Blended learning through use of a combination of "Moodle" and "VC sessions"	Local workshop conducted through the use of the "face-to-face" approach	Follow-up, monitoring, and evaluation using a combination of "face-to-face" and "online-based" modes to develop policy implication and CAP
Duration	2 weeks	3 days	1.5 months
Learning tool	• Moodle • VC sessions • E-mails	• Face-to-face workshop • Moodle (for information- and experience-sharing purposes among concerned parties including workshop presentation materials, outcomes, interview videos of city representatives)	• Face-to-face workshop in each city • Moodle • VC sessions • E-mails

Table 1. (*Continued*).

	Stage 1	Stage 2	Stage 3
Mode of contents	• Written learning materials (including case studies, web quest) • Explanatory video to cover overall course explanations • E-mail group communicating with facilitators/discussion forum space • Two VC sessions with instructional presentations and Q&A • Live streaming and video on demand (VoD)	• Presentations on instrumental subjects • Tasks on "Draft Climate Action Plan," "HFA Task for Local Stakeholder," "Self-evaluation Matrix" • Site visits (Kampong Bahru) • Exercise and group presentations	• Group work • Two VC sessions with consultation for finalizing policy framework and CAP • Template formats and explanatory notes for policy framework, CAP, and monitoring indicators • E-mail and Moodle-based consultation

(i.e., Moodle) was used for the CDRI. Moodle is a course management system (CMS) that is a free Open Source software package designed to help educators create effective online courses based on sound pedagogical principles. Through the use of Moodle as a learning platform, the program was designed as a comprehensive program from the self-paced learning part (core module), submission of final outputs, and monitoring and follow-up of a postprogram stage. The platform can also be used to store all the documents and records created during the program implementation that participants can always access and refer to whenever they need those materials. Other technology, including VC, was continuously used not only for the program implementation period but also for the monitoring and follow-up period after completion of the program.

A set of learning materials and the program structure enhanced participants' learning process. The volume of core learning materials for Stage 1 and the overall level of information to be posted to the website were well discussed among partners. The core learning materials were developed by Kyoto University and SEEDS. All partner organizations agreed that the materials would contain learning contents directly related to helping with the CAP writing for a target audience group who are quite busy with their daily work. Other instrumental materials and references were provided by

all program partners, who closely monitored progress and responses from participants and provided necessary materials to help their work. These were all posted to the Moodle site to be shared, and some key materials were used in VC sessions. It was also important to respond to and provide participants with guidance on any enquiries by e-mail or the Moodle discussion page to support participants' learning process.

The design and selection of learning materials supported the roles and requirements of participants and were clearly set during the program design process. In Stage 1, each participant completed the online-based self-learning course and participated in two VC sessions (or streamed videos). Then each participating city submitted the CDRI questionnaire. In Stage 2, each participant was required to create a self-evaluation matrix and develop a specific action agenda with a time frame to enhance urban resilience in their respective cities. In addition, active experience-sharing among the various participating cities was required during the F2F workshop. In Stage 3, each participating city formed a working group to develop their CAP, incorporating with decisive actions and specific time frames by examining policy formulation.

Result of the CDRI Capacity-building Program

An overall program evaluation was conducted after the completion of the last stage (Stage 3) of the program. The evaluation of each stage was conducted as part of the process within each stage. The format of each evaluation was either an online-based questionnaire or participants' feedback questionnaire on site with direct communications with participants. The criteria and evaluation results of the overall program are discussed in this section, including result summaries for each evaluation.

Overall, program assessment was very positive, with an average rating of 4.2 out of 5. Responses to open questions were also very positive. Participants expressed a great appreciation for several particular areas. First, they evaluated the level of knowledge gained through this program highly. Understanding HFA principles and the linkage to the five key dimensions of urban resilience as well as the CDRI and HFA linking session in the workshop helped participants establish a new model and plans for city resilience. It was also beneficial for participants to have knowledge- and experience-sharing opportunities with participants from other cities. Cities' real experiences (i.e., case studies) were very stimulating and informative for other cities. In addition, this program facilitated awareness-raising and opened up avenues

for new ideas and ways to address urban issues, including the incorporation of disaster risk management and climate change at all levels. Another important feedback was that the program was useful for city government employees to identify key stakeholders for further work. This is very important in terms of the sustainability of their activities during subsequent steps.

Second, the effectiveness of learning tools also received high marks from participants. Learning methodology and tools were recognized as being effective. This program could reach out to more participants in each city and provide them with more scientific and systematic approaches to developing CAPs that have previously not been fully used in their context. In addition, participants appreciated the time flexibility for learning issues particularly for high-ranking people who often found it difficult to block out some quality time for learning in a classroom. Although the self-learning part was effective for making individual participants actually work, the outreach, time flexibility in the learning environment, and the integration of a more dynamic discussion were important factors for generating a synergistic effect to effectively use distance learning. Regarding the usability of online tools, participants' ratings increased during later stages of the program, yet some participants still encountered difficulties using them. Additional comments recommended improving subsequent program implementation by including more case studies, city-based consultations, and VC sessions. The program was very challenging given that participants had to develop a CAP within a relatively short period of time. These points as well as other identified issues will be examined in order to revision to process for the next course implementation. The following paragraphs highlight the evaluation results of each phase.

The evaluation of Stage 1 was conducted using an online-based questionnaire that was a combination of rating and open questions. The main criteria for evaluation were as follows: (i) understandability of Stage 1 learning process, a linkage among Stages 1–3; (ii) relevancy of learning materials to participants' work, needs of participants' organization/city, completion of the CDRI questionnaire; (iii) usefulness of knowledge gained; (iv) level of inspiration derived from the Stage 1 for more learning; (v) overall quality of VC sessions and VC technology; (vi) level of Moodle usability; (vii) effectiveness of learning mode in Stage 1; (viii) level of matching Stage 1 contents to objectives of the program announcement; and (ix) overall quality of learning package and overall usefulness of Stage 1. The overall result of Stage 1 was positive, with an average rating of 3.8 out of 5. Relevancy, knowledge gained, learning modality, and quality of the learning package ranked highest. The evaluation results with some key criteria are shown in Fig. 3.

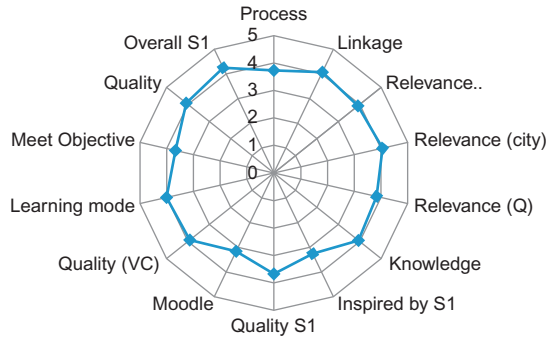

Fig. 3. Evaluation Results of Some Key Factors of Stage 1 (Marked Question Only, 1 is the Lowest; 5 is the Highest).

Some cities showed a great interest in VC sessions in terms of receiving explanations and instructions about learning subjects and meeting with other participants to discuss the topic. In addition, sharing experiences with others and gaining insights into lessons they learned were highly appreciated. However, VC was a new tool for some participants; they required more time to become familiar with such a learning environment, particularly during the earlier stages of course implementation. Participants thought the core learning materials and references were useful, but they actually wanted to have more case studies and audio-visual learning materials to enrich the learning module. The use of social media was also suggested for continuous discussion beyond the project period.

Participants evaluated Stage 2 through a participant feedback questionnaire and individual interactions with participants, resource persons, and facilitators during the period of the workshop. The main criteria for the evaluation were as follows: (1) expectations being met; (2) relevancy of the content activities; (3) networking achieved through the course; (4) contribution made and utility thereof; (5) contents in terms of quality and applicability; (6) speakers and facilitators, and the quality of delivery; (7) time allocation for various activities in the workshop; (8) logistics arrangements and efficiency; (9) adaptation to the specific needs for the course; and (10) follow-up processes of the program. Overall results of Stage 2 were positive, with a higher rating for all criteria; contents and speakers and facilitators rated highest. Evaluation results with some key criteria are shown in Fig. 4.

Other key feedback was also encouraging such as (i) usefulness of peer learning through experience-sharing with other cities, (ii) enhanced

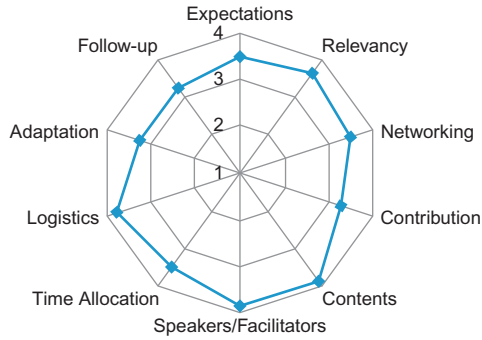

Fig. 4. Evaluation Results of Some Key Factors of Stage 2 (Marked Question Only, 1: Not At All, 2: A Little, 3: High, 4: Very High).

understanding of the linkage between climate resilience and disaster-risk reduction through exercises of CDRI- and HFA-linking sessions that enabled participants to help establish a new model in their context, (iii) clarity of the role of key players (local government), (iv) the learning of a new approach to risk reduction and climate change management that can be used for actual implementation at the ground level, and (v) usefulness of the field trip that provided participants with great experiences for collecting data and observing real life in a community. Meanwhile feedbacks provided regarding how to improve the program included (i) addressing time constraints, particularly in view of language challenge among cities, by providing greater flexibility and promoting the advantages of the blended learning methodology; (ii) following-up after the Stage 2 workshop and continually monitoring Stage 3, during which CAP was developed by each city; (iii) collecting and using more case studies, information, statistics etc., to make the program richer in subsequent program implementation cycles; and (iv) creating a database and research papers or reports on the application of the models and results to also make the program more comprehensive.

The evaluation of Stage 3 was conducted using an online-based questionnaire that was a combination of ranking (for Stage 3) and open questions (for all three stages). The main criteria for the Stage 3 evaluation were as follows: (i) understandability of Stage 3 information; (ii) usefulness of knowledge gained; (iii) relevance of instruction package; (iv) the matching of Stage 3 contents and expectations; (v) level of inspiration derived from Stage 3; (vi) level of Moodle usability; (vii) learning mode of Stage 3; (viii) level of satisfaction with VC session, technology, and content quality; (ix) overall Stage 3 content

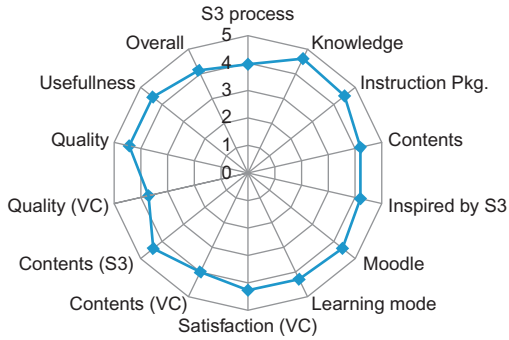

Fig. 5. Evaluation Results of Some Key Factors of Stage 3 (Marked Question Only, 1 is the Lowest; 5 is the Highest).

quality and usefulness; (x) learning package quality; and (xi) overall assessment of Stages 1–3. The overall results from Stage 3 were positive, with an average rating of 4.2 out of 5. Usefulness of knowledge gained, relevance of instruction package (including guidelines note and template), quality of learning package, and usefulness of Stage 3 ranked highest.

Evaluation results with some key criteria are shown in Fig. 5. Major comments on Stage 3 focused on the usefulness of the explanatory notes for CAP and the Policy Framework and the effectiveness of VC sessions as a complementary learning part. This suggests that such learning tools provide key players in cities with concise guidelines for developing CAP and policy framework.

All cities successfully submitted these documents; some cities are still working on the further restructuring and polishing of the CAP in order to receive endorsement from their city mayors. Makati City was the first city to receive endorsement from its mayor in June 2010, which was very encouraging news for the program organizers and other cities. Makati is a successful case in this context as the plan was integrated into the city planning and will be institutionalized. The program organizers expect to have more cities gain such endorsements from their mayors soon.

LESSONS FROM CDRI CAPACITY-BUILDING PROGRAM AND ITS IMPLICATIONS

CDRI Capacity-building Program finished with promising outputs, receiving favorable feedback and comments for review and reflection to enhance subsequent program implementation. The outputs of the program are now

moving on to the next stage, during which actual projects listed in the CAP will be implemented in each city. CDRI Capacity-building Program started as a stand-alone program with clear objectives and a set of outputs. However, it has also a process for following subsequent actions taken by each city based upon their CAPs that makes it possible to determine if the ultimate goal is achieved. This shows how the program is strategically set toward overall development goal – namely, to enhance climate and disaster resilience in Asian cities. As Otoo, Agapitova, and Behrens (2009) said, ''Capacity development efforts – whether stand-alone programs (with complementary resource inputs made available separately if needed) or contained in lending projects – are just a part of the larger process of development.'' It is essential to understand how the capacity-building program can be established in a broader perspective when it is designed. It will be different by specific goals and objectives of each program. Yet it is also important to understand that the capacity development effort is not concluded in itself in terms of the real impact of the program. In the case of CDRI Capacity-building Program, the scope of the program continues until each participating site submits its CAP. As such, the stage during which actual project implementation is carried out is beyond the original scope, unless we include the follow-up process, which would make the program more comprehensive and enable people to continuously measure the impact of the program.

With these points in mind as well as the program evaluation results, several significant lessons and implications can be drawn from program evaluations. First, the identification of a target group of people to accomplish the objectives is justified. The target group is a potential group of people who can make a change in their own context. In the program, local government officials are the primary targets who can carry out actions and changes, as being demonstrated in the case of Makati. Second, outcomes should always be in place to measure the level of achievement. A set of outcomes at each stage was clearly defined, making it easy to assess the level of completion at each stage in order to move on to learning activities in subsequent stages. Such assessment and follow-up were very important for program organizers, who could adjust the contents, by preparing and adding materials to support learning activities throughout the program. Third, the program has a result chain linking development goals, specific program objectives, and specific learning activities. The sequence of the chain is to include the process to achieve the program objectives through learning activities (core subject learning, completion of questionnaires, presentations on subject topics, consultation, and creation of draft and final CAP) and actualize the CAP, which will culminate in the attainment of

development goals. Finally, follow-up and monitoring processes to ensure that participating cities will take initiatives are built into the program not only to measure the impacts of the program but also to provide more opportunities to link with other instruments to contribute to accomplishing objectives after completion of the program.

Additional key lessons of the program include that all partner organizations collaborated very well and played complementary roles in an effective and efficient manner. Since the program was planned by optimizing the unique set of resources, skills, and assets of each partner organization, designing the program comprehensively, roles and responsibilities were clear from the beginning. Other notable points were the strong commitment from each partner organization and each partner's respect for the specialties and profession of others. Furthermore, partner organizations and the group of participants played an essential role. Because CITYNET and Kyoto University already had working experiences with some of the participating cities, the current situations and environments of their cities were well known beforehand. In addition, a trusting relationship had already been developed between the program organizers (partner organizations) and recipient cities. This was very beneficial for both ends, especially for the first implementation of the program.

The ways of learning vary from individual to individual, and there is no perfect learning model to fit everyone. However, blended learning program can be one of the most powerful tools for helping people learn if methodology and tools are applied to programs in the most appropriate manner. In addition, the combination of self-paced learning, group works, and pragmatic hands-on exercises is very effective for enhancing learning. These important points will make the program more useful and practical for participants. The application of ICT tools in the design of blended learning programs should be examined in line with the objectives, types of target audiences, expected outputs and anticipated impacts, available resources, and so forth. The use of inappropriate tools or an overly complicated program design would be of no benefit to the target participants and program organizers. The tools used in the program also help follow up sequential actions taken by participants and assess the impact of the program. It should be feasible in terms of course management, learning process, and achievement of program objectives. Some areas of CDRI Capacity-building Program should be further reviewed, including a contents design part and the use of other ICT tools. This will help ensure that the program becomes one of the models for facilitating capacity building, thereby raising the level of city resilience on a broad scale.

With the changing focus of capacity development programs, this chapter used CDRI Capacity-building Program as a case study for the use of blended learning methodology; success factors of the program were also examined. The program is just one of many examples, and it has been delivered only once as a pilot at this stage. Yet this experimental program delivery offers much to be learned in terms of design, implementation, monitoring, and follow-up. Indeed, there is much room for the use of blended-learning with sound program planning to achieve sustainable results, particularly in the disaster risk management area, where various types of people need to gain further knowledge and skills to prepare and mitigate disaster risks in their own contexts. Although there are challenges due to the difficulties of creating training programs in a disaster risk management area where people are in multidisciplinary environments, once strong demands are identified, the target groups are well selected with clear goals and objectives, and appropriate learning design and tools are applied; distance learning and blended learning make it possible to significantly scale up training both in individual countries and at the regional and global levels. In this regard, the case of CDRI Capacity-building Program is a good example for how such a program works.

ACKNOWLEDGMENTS

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CHAPTER 11

BUILDING LOCAL GOVERNMENT RESILIENCE THROUGH CITY-TO-CITY COOPERATION

Bernadia Irawati Tjandradewi and Kristoffer Berse

INTRODUCTION

The latter half of the 20th century has seen the rise of local actors in the international milieu. Among these so-called local "internationals" (Alger, 1999) were local governments who have come to assert their role in various aspects of international development. Since the end of World War II, municipalities have actively forged partnerships with other localities in other countries,[1] even to the point of challenging the foreign policies of their own countries in such thorny issues as the apartheid in South Africa, nuclear disarmament, human rights, and the Sandinista war in Nicaragua (Hobbs, 1994; Shuman, 1994; Fry, Radebaugh, & Soldatos, 1989). The importance of municipalities as global players has grown substantially over the years. At the Earth Summit in Rio de Janeiro in 1992, among the major issues highlighted in the Agenda 21 was the need to devote "greater attention to issues of local government and municipal management" (UNEP, n.d., 5.3). It further pointed out that in order for cities, especially those plagued by severe sustainable development problems, to develop

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along a sustainable path, they should, among others, ''participate in international 'sustainable city networks' to exchange experiences and mobilize national and international technical and financial support'' (UNEP, n.d., 7.20.d) and ''reinforce cooperation among themselves'' (UNEP, n.d., 7.21). Four years later, at the UN-HABITAT II City Summit in Istanbul, cities were officially recognized by the United Nations as the ''closest partners'' of national governments for the implementation of the Habitat Agenda (UN-HABITAT, 2003). In 2005, as a demonstration of their commitment to work for the achievement of the Millennium Development Goals (MDGs) on the ground, over one thousand cities and local government associations issued and adopted the Local Government Millennium Declaration at the Millennium+5 Summit in Beijing (UCLG, 2010).

To date, it is estimated that 70 percent of cities worldwide are connected to municipalities from other countries in one way or another. This upsurge in ''municipal internationalism'' (Hewitt, 1999) was spurred by a confluence of push and pull factors. There are the increasing challenges brought about by the triumvirate forces of globalization, urbanization, and decentralization (UN-HABITAT, 2003), compelling municipalities to seek solutions that have proven to work elsewhere and tap complementary resources outside the traditional ambit of their national governments. Fortunately, this twin need for additional resources and adaptive learning have been met by the global scaling down of national barriers, by fundamental changes in international development cooperation strategies (Hafteck, 2003), and by technological advancements especially in transportation and telecommunication (Castells, 1996). Taken together, these factors triggered the urgency and, at the same time, laid down the path for local governments to link up with each other. With more than 50 percent of the global population projected to live in urban areas, mostly in developing countries, by 2030, it is expected that cooperation at city level will continue to rise as one of the important tools in sustainable urban development (Tjandradewi, Marcotullio, & Kidokoro, 2006).

At the heart of this international municipal movement are local government associations or networks. It is estimated that approximately 68 percent of international municipal linkages have been channeled through international associations (UN-HABITAT, 2001). In Asia, city networks perform an important intermediary role for the implementation of city-to-city cooperation (C2C). Tjandradewi and Marcotullio (2009) noted that network-facilitated C2C has much potential as a modality for carrying out urban development projects in Asia. As a development strategy, C2C has

received considerable attention in the agenda of development agencies in recent years. For instance, it was included as part of the capacity building strategy and action plan of the Cities Development Initiative for Asia (CDIA) for 2010–2012.[2] ADB's Urban Sector Strategy underscored the importance of networking and cooperation to "share best practices, cross-fertilize innovation, and promote new ways of problem solving" (ADB, 1999, p. 29).

This chapter discusses the role of city networks in facilitating the local implementation of climate and disaster resilience measures in Asia, primarily through C2C. It uses the experience of CITYNET, a regional network of local authorities for the management of human settlements in the Asia-Pacific, as a case study. Following this introduction, an overview of local government networks and the nature of cooperation they foster is presented. It then discusses the experience of CITYNET and draws out key ingredients for and barriers to the success of C2C, in relation particularly to climate change adaptation and building resilient cities in the Asia-Pacific region. The last two sections discuss implications and general conclusions, respectively.

THE ROLE OF LOCAL GOVERNMENT NETWORKS

Overview of Local Government Networks

As the international interconnectedness of cities has grown in both number and scope (Zelinsky, 1990, 1991; Gilbert, Stevenson, Girardet, & Stren, 1996; Tjandradewi & Chahl, 2001; UN-HABITAT and UTO/FMCU, 2002), so have local government networks. From the founding of International Union of Local Authorities (IULA) in 1913 (Saunier, 2001), the first international association of municipalities whose structures and influence have persisted up to this day,[3] international urban networking has steadily grown since 1980s (Friedmann, 2001). Their purpose has also expanded from post–World War II cultural and pacifist objectives to a broad spectrum of local development concerns, from disaster risk reduction to sustainable transportation to climate change. By 2004, 53 international city networks, which deal with sustainability issues alone, have been reported (Keiner & Kim, 2007).

Within Asia, a number of city networks exist whose agenda include, inter alia, fostering intercity cooperation among cities in the region. Most of these networks, however, have been established fairly recently, the earliest

regional association being CITYNET, which was founded in 1987 (Table 1). It also indicates that, set aside for UCLG-ASPAC, networks with Asia-Pacific coverage are all headquartered in Japan, which tends to mirror the dominance of the country in the region. Operationally, five of the city networks listed below, namely, CITYNET, ICLEI, Metropolis, UCLG ASPAC, and the Alliance for Healthy Cities, collect membership fees to augment their own programs and projects.

Table 1. Profile of Selected City Networks Involving Asian Cities.

Network	Membership/ Coverage	Secretariat (Location)	Year of Establishment
Metropolis – world association of major metropolises	International	Metropolis (Barcelona)	1985
CITYNET – regional network of local authorities for the management of human settlements in Asia and Pacific	Regional	CITYNET (Yokohama)	1987
ICLEI – local governments for sustainability	International	ICLEI (Bonn)	1990
APCS – Asia-Pacific City Summit	Regional	Fukuoka Asian Urban Research Center (Fukuoka)	1994
KI – Kitakyushu Initiative for a Clean Environment[a]	Regional	IGES (Kitakyushu)	2000
EMI – Earthquakes and Megacities Initiative	International	EMI (Metro Manila)	2000
ANMC21 – Asian Network of Major Cities 21	Regional	Tokyo Metropolitan Government (Tokyo)	2001
The Alliance for Healthy Cities	International	Graduate School of Tokyo Medical and Dental University (Tokyo)	2003
UCLG-ASPAC – United Cities and Local Governments Asia-Pacific	Regional	Jakarta (Indonesia)	2004
C40 Cities – Climate Leadership Group	International	C40 (London)	2005

Sources: Adopted from Tjandradewi and Marcotullio (2009) with modifications from Ishinabe (2010).

[a]The program was ended in March 2010. IGES and Kitakyushu have launched the extension of the Kitakyushu Initiative for a Clean Environment under the name of ''Kitakyushu Asian Center for Low Carbon Network'' this year.

Local Government Networks and C2C

Extant studies point to the importance of city networks in generating local-level information and sharing knowledge, expertise, policies, and practices among their memberships. UN-HABITAT (2003) particularly noted that city networks, through C2C, could enhance the capacity of local governments in the following areas: (a) information and technical expertise, (b) policy development and decision-making, (c) institutional strengthening and human resources development, (d) managing change and using external support, and (e) policy implementation. Other studies point to the vital contribution of networks in the development of joint projects in business and research and in increasing the international presence of the city (Nakamura, Elder, & Mori, 2010). Moreover, network-facilitated C2C are credited not only for enhancing the capacity of local governments (Tjandradewi et al., 2006) but also for providing a common focus or direction on certain issues (Ishinabe, 2010). In some cases, this leads to the development and implementation of specific action plans and policies.[4] The advantage of networks in promoting C2C lies in their primary function as clearinghouses of information (Keiner & Kim, 2007), that is, both as a generator and disseminator of knowledge (Trullén & Boix, 2003). They also provide a legitimate forum for the articulation of issues and even the formulation and implementation of specific action plans.[5]

By type of activities, Nakamura et al. (2010) identify four areas that international environmental networks in Asia are involved in. These are (a) financial and technical cooperation, (b) capacity building, (c) domestic institutional development, and (d) promotion of bilateral intercity cooperation. They further reported that capacity building activities are carried out through (a) direct interpersonal communication (e.g., meetings to share knowledge and experiences, seminars and workshops, training, study tours, dispatch of experts, and consultation), (b) information and research (e.g., creation of successful practice databases, development and sale of case study compendiums, implementation of research and studies, and development and sale of reports and manuals), and (c) online materials (e.g., publication of documents and workshop materials on websites and provision of activity support tools).

Overview of CITYNET

CITYNET was established in 1987 at the Second Congress for the Development of Human Settlements in Asia and the Pacific organized by

ESCAP and the City of Nagoya, Japan. At that conference, 26 city authorities and 11 nongovernment organizations (NGOs) and government agencies adopted the Nagoya Declaration, creating the Regional Network of Local Authorities for the Management of Human Settlements in Asia and the Pacific or CITYNET (Hosaka, 1993). By bringing together local authorities in the region, the network is envisioned to promote people-friendly cities in the Asia-Pacific that are environmentally sustainable, economically productive, politically participatory, culturally vibrant, socially just, and globally connected (Tjandradewi & Marcotullio, 2009). CITYNET's overarching goal is to facilitate the transfer of best practices between and among its members through C2C. Membership to the network is divided into two categories, namely, full and associate. Full members comprise local authorities in the Asia-Pacific region, while associate members represent national level organizations (e.g., national municipal associations, development authorities etc.), NGOs and community-based organizations (CBOs), research, training and academic institutions, private companies, and local authorities outside of the region.[6]

C2C is conducted under CITYNET primarily through study tours, technical advisory services, and pilot demonstration of best practices that have proven to work in one of the member cities. CITYNET also organizes specialized training programs, workshops, and seminars whereby cities get to know the conditions, needs, and best practices of other members in the network. This is complemented by an active documentation and dissemination of network-relevant activities, as well as joint research projects. CITYNET's C2C strategy has proved to be effective in diffusing tested policies, practices, and technology, as best exemplified in the long-term partnership between Yokohama and Penang, which has covered important aspects of urban design, road administration, and solid waste management (Tjandradewi et al., 2006).

The uniqueness of CITYNET's approach lies in the composition of its membership. The participation of Associate Members (e.g., NGOs/CBOs, private companies, etc.) greatly complements and augments the capacities of the municipal participants in various areas, from solid waste management to environmental education to transportation planning. Another unique feature is CITYNET's reliance not only on assistance and solutions from developed cities but also on tested sound practices from those in developing countries. Developed as part of its Technical Cooperation among Developing Countries (TCDC) program, South–South linking is considered to be an effective modality for C2C in Asia, as elsewhere, since the partners are usually similar in one way or another, whether geographically,

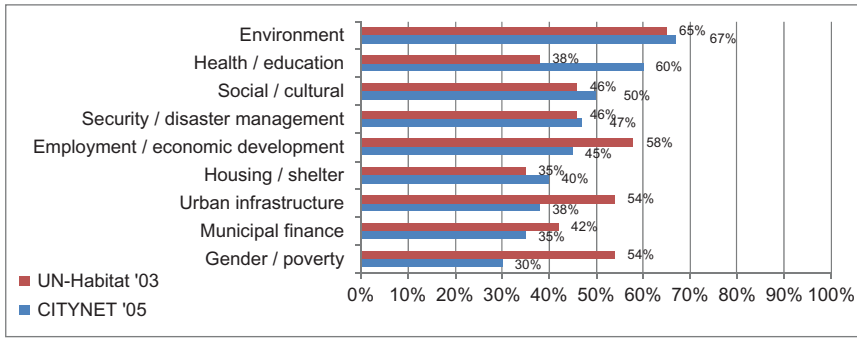

Fig. 1. C2C Priority Areas, According to CITYNET Member Cities and Selected Intercity Networks. *Source:* Ishinabe (2010).

economically, socially, or culturally (UN-HABITAT, 2003). To date, CITYNET has supported approximately 500 municipal exchanges among its members.

In a survey among CITYNET members, Tjandradewi and Marcotullio (2009) reported that C2C is perceived to be most beneficial in the areas of environment, health, and education; social and cultural issues; and security/disaster management. Of lesser interest was C2C work in the areas of gender and poverty, municipal finance, and urban infrastructure (Fig. 1). The primacy of environment in C2C is also reflective of the actual C2C activities of other intercity networks (UN-HABITAT, 2003). Currently, CITYNET structures its C2C activities along four clusters, namely, climate change, disaster risk reduction, infrastructure, and MDGs. The next section details CITYNET's C2C experience in the interrelated areas of climate change and disaster risk reduction.

Evolution of Disaster-Related Activities in CITYNET

First Training Program on Disaster Mitigation

CITYNET began its activities on disaster-related issues only in 2003 when the City of Yokohama, the Presidency City and the host of Secretariat, proposed to the Japan International Cooperation Agency (JICA) to support CITYNET's training program on disaster mitigation. The activity marked the first joint activity undertaken by CITYNET and JICA addressing the need for capacity building of local governments in disaster mitigation and

management. This issue was taken up recognizing the strengths of Yokohama, which, like some other cities in Japan, has a comprehensive strategy for disaster prevention and emergency management. This two-week training was participated by five city officials from Colombo (Sri Lanka), Gorontalo (Indonesia), Makati (Philippines), and Mumbai (India) who identified cyclones, typhoons, floods, landslides, fire, and earthquakes as most common type of disasters (Mumbai and Colombo also identified manmade disasters). Through the training program, they were able to understand that the role of local government was not only to respond to and recover from a disaster but, more importantly, to reduce/minimize losses from the disaster, if not totally prevent it from happening (CITYNET, 2003). Although the disaster-related systems of Japanese cities (in this case, Yokohama and Kobe) were much advanced, the participants found the practical aspects of the training more useful and applicable to their cities. These include, for example, the town watching methodology, which turned to be an eye-opener for the trainees as they were able to identify vulnerable areas to disasters using this practical method. Other lessons learnt were the comprehensive development plan for disaster-resistant housing, GIS, appropriate waste management, well-maintained storm water system, application of building codes for resilient buildings, as well as the participation of citizens and various stakeholders in raising awareness on disasters. The change in perception by the city officials concerning their role was reflected in the lessons learnt and action plans they submitted after the training, as summarized in Table 2.

Establishment of Disaster Cluster within the Network

A series of natural disasters has greatly affected cities in Asia in recent years, such as the 2004 Indian Ocean earthquake, which triggered a tsunami killing 230,000 people in 14 countries (in which Indonesia was the hardest hit, followed by Sri Lanka, India, and Thailand); the 2005 Maharashtra floods, which affected a large part of Mumbai, Vice-Presidency City of CITYNET, leaving at least 1,000 people dead; and the 2005 Kashmir Earthquake. In the aftermath of disasters hitting the region, the CITYNET Secretariat has mobilized support among its members, matching the needs of those affected with the available resources from members and partners through its website. Led by the President of CITYNET/Mayor of Yokohama at that time, fund-raising activities were organized in Yokohama, in which the collected money was later on spent for the construction of community-based support facilities in Banda Aceh (Indonesia) and Galle and Moratuwa (Sri Lanka), a public school in Muzaffarabad (Pakistan), and a public market in Banda Aceh.

Table 2. Identified Action Plans for Disaster Risk Reduction in Selected Cities.

City	Proposed Action Plans
Mumbai	Proper coordination among departments; upgrading of emergency department and its information system (including software); implementation of flood preventive measures; cooperation with NGOs/CBOs; and improvement of training contents.
Gorontalo	Regulation of the city's greenery; introduction of forest and water conservation; improvement of data collection on floods; identification of disaster-vulnerable areas using GIS; establishment of a GIS laboratory; and strengthening of institutional capacities for disaster management.
Kathmandu	Insertion of the building code in the Capital City Act; establishment of coordination mechanism between local government, other neighboring municipalities, and NGOs; installment of GIS for disaster management; provision of equipment for the prevention and emergency management unit; improvement of human resources including municipal employees, NGOs/CBOs, and schoolteachers; and deployment of evacuation drills at schools.
Makati	Inclusion of the green matrix concept in urban planning as shared by the City of Yokohama; good coordination between members and officials of the Makati City Disaster Coordinating Council; field exercise on hazard mapping (involving staff from relevant departments); training on GIS and the upgrade city maps with GIS; establishment of mini-library on disaster mitigation where citizens can have access for researches and study purposes; and establishment of the Makati Emergency Management Centre as 24-h monitoring and coordinating centre for all emergency operations.[a]
Colombo	Improvement of coordination within departments and other stakeholders; updating of database and GIS implementation; engagement with the private sector and other utility agencies; training for employees and the Community Development Council's leaders; conduct of fire drills; establishment of an Emergency Management Unit; and strengthening of the function of the Colombo Municipal Council vis-à-vis the national level disaster management council.

Source: CITYNET (2003).

[a]This was officially launched in September 2006 as the Makati Command Control and Communication (C3). Located at the top floor of the City Hall, C3 has been one of the city's showcases to visitors from the Philippines and abroad.

CITYNET also facilitated the dispatch of city officials and technical personnel to the affected cities to support rehabilitation planning. To institutionalize its disaster risk reduction agenda, a Disaster Cluster was created, upon the suggestion of Yokohama, at the CITYNET Congress held in Hanoi in September 2005. The Cluster will support members in disaster mitigation and management by building stronger institutional capacity of local governments. Proposed activities of the Cluster included a community awareness-raising

program on disaster preparedness (in Islamabad), city-to-city transfer of knowledge on disaster management, local governments and civil society partnership, training and capacity building on disaster preparedness, and the creation of institutional structure in individual cities for disaster preparedness. While all planned activities were implemented, the remaining activities, such as the development of a database on emergency services in individual cities, which would allow CITYNET to communicate directly during a crisis, are yet to be implemented. Makati expressed its interests and eagerness in this particular area and has served as the Co-Chair/Lead City of the Disaster Cluster from its early stage until now. Although Yokohama did not serve as the Lead City, the city continued providing technical cooperation by sending their city officials to disaster-affected cities, as well as by hosting the Cluster's activities.

Disaster Risk Reduction and Climate Change Adaptation

The issue of disaster risk reduction and climate change adaptation was brought to the network mainly by external development agencies (e.g., World Bank and UNISDR) and the academe (Kyoto University). The World Bank and UNISDR have partnered with CITYNET to gather feedback from local governments in relation to their project on "Reducing Vulnerability to Climate Change Impacts and Related Natural Disasters in East Asia." Engagement of the CITYNET's Secretariat with the Asia Regional Task Force on Urban Risk Reduction (RTF-URR)[7] in November 2008 also provided an opportunity for CITYNET to learn and share information and expand its networking. Facilitated by UNISDR, CITYNET was also part of the advocacy effort spearheaded by UCLG to promote local action for disaster risk reduction. It joined the "Partnership on Urban Risk Reduction (PURR)" through a Memorandum of Agreement with UCLG in April 2008.[8] The partnership has three main goals, namely, (1) to launch worldwide awareness campaigns for local authorities about risk reduction; (2) to strengthen capacity at the local level to better manage risks by transferring technical know-how to local actions and decision makers; and (3) build and strengthen a global platform for local authorities and their partners in order to promote a sustainable strategy for disaster risk reduction. An intensive work of CITYNET, Kyoto University, UNU, and UNISDR in profiling the climate resilience of 10 coastal cities in 2008–2009 resulted in the publication of "City Profile: Climate and Disaster Resilience" released in 2009. Following the compilation of data and publication, the team together with UNITAR held the training on climate and disaster resilience in coastal Asian cities in February 2009 in Danang (Vietnam), which aimed at raising the capacity of local governments and other local

actors on disaster risk reduction by assessing different dimensions of resilience, namely, social, economic, institutional, physical, and natural.

Mainstreaming Disaster Risk Reduction in City Planning and Management
Continued work on mainstreaming disaster risk reduction was further strengthened through the Climate Disaster Resilience Initiative (CDRI). This resulted in the development of action plans in nine participating cities.[9] The action plans were developed in a participatory manner; hence, the level of participation was different in each city. Makati's action plan was noted as the most participatory-developed plan, involving the biggest number of participants from both within and outside the city government. The evolution of disaster-related activities in CITYNET demonstrated the paradigm shift of local governments from responding to and recovering from disasters, to reducing and mainstreaming risks in their city planning and management. The evolution was made possible due to a number of factors. One of them was the vision set by the Presidency City of CITYNET, the City of Yokohama, which has comprehensive measures in all stages of the disaster cycle, namely, response, relief, recovery, mitigation, preparedness, and early warning. The cases from Yokohama and other Japanese cities (particularly Kobe) have also inspired other Asian cities to realize that disaster risk reduction is not only about physical/infrastructure improvement but also about institutional strengthening, capacity development, and enhancement of the governance system. It likewise instilled in them the importance of participation and cooperation not only among concerned government departments and agencies but also among community members, private sector, and the local government. The local enforcement of laws and regulations, along with the regular collection of updated and pertinent data, has also been highlighted in these inter-municipal exchanges.

Another reason was the flexible C2C platform set up within CITYNET, which allows for technical cooperation through sharing of best practices between and among its members and other local actors. A recent example was the cooperation between Makati and Kathmandu, which involved officials exchanges aimed at assessing the disaster management and land pooling systems in Kathmandu Metropolitan City. The uniqueness of this particular engagement was that it formed part of a larger project by a partner network on mainstreaming disaster risk reduction and emergency management in the two cities.[10] Fig. 2 shows the C2C framework developed by the CITYNET Secretariat. C2C takes place when two or more city members agree to cooperate as beneficiary and resource cities

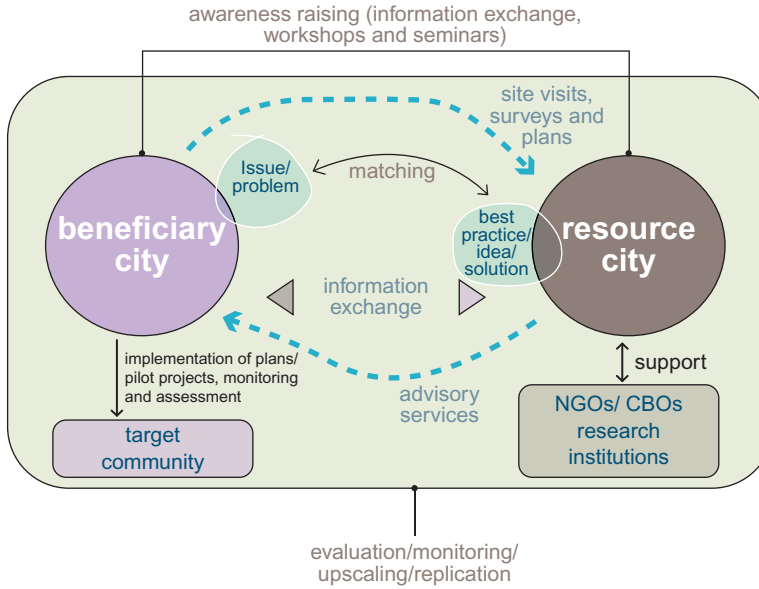

Fig. 2. C2C Framework Developed by CITYNET Secretariat.

over a certain period of time. In order to be successful, the partnership, which can be bilateral (one-to-one) or multilateral (one-to-many) in nature, must have a clear set of objectives and expected outputs/ outcomes. Upon careful matching and initial exchange of information facilitated by the Secretariat, participating cities then identify the type of activities that the cooperation would entail. This may include site/study visits, surveys, technical advisory services (dispatch of experts), as well as local trainings, workshops, and seminars. When a beneficiary city is simply interested in a best practice from the resource city, a structured study visit may be arranged. A resource city may visit the beneficiary city to understand the latter's problems and offer concrete solutions based on its own experience. A pilot project may also be carried out to demonstrate the benefits of a best practice transfer that the beneficiary has adapted from the resource city. From these short-term municipal exchanges, long-term twinning arrangements may be formed, which usually involve wider areas of concern and set of activities. Throughout this process, NGOs/ CBOs, research institutions, and other stakeholders in both cities play important support roles. The CITYNET Secretariat is responsible for

monitoring and evaluating the cooperative framework, and assessing possible scale-up of achievements in much wider areas within the city or somewhere else.

As pointed out earlier, external agencies (e.g., international/development agencies and the academe) have also contributed significantly in reshaping CITYNET's strategies and approaches. For instance, they have assisted in assessing the level of development and preparedness of Asian cities with regard to their resilience to climate change, and in comparing them based on a set of indicators (applicable for hydro-related disasters). The role of external agencies like the UNISDR in advocacy (e.g., recent launching of the ''Building Resilience Cities'' Campaign) could provide more opportunity for national and local governments to pay attention to the creation of disaster-resilient cities. Despite the availability of tools and indicators to rank the level of urban resilience, it might be necessary to have a global understanding of the various assessment tools to avoid confusion among users, especially local governments.

Furthermore, in the recent Asia-Pacific workshop on urban safety organized by CITYNET, UN-HABITAT, and UNESCAP and hosted by the City of Marikina (Philippines) from June 15 to 17, 2010, local governments and local actors indicated much broader definition/meaning of urban safety, in which unlike in other parts of the world, i.e., Latin America and Africa, it goes beyond crimes and violence to also include safety from natural disasters. The workshop was held as part of the project of ''Urban Safety for the Poor'' initiated and launched by UN-HABITAT. It resulted in the essential review of the program on how to bring urban safety in Asia and the Pacific region.

KEY INGREDIENTS TO THE SUCCESS OF C2C COOPERATION

A number of elements have been identified as critical to the success of C2C cooperation (Tjandradewi et al., 2006; Tjandradewi & Marcotullio, 2009). These are (1) commitment to link, (2) community-wide participation, (3) understanding, (4) reciprocity, (5) result through real examples, (6) political support from higher levels of government, (7) consistent leadership, (8) cost sharing and cost effectiveness, and (9) free flows of information (Tjandradewi et al., 2006; Tjandradewi & Marcotullio, 2009). The role of CITYNET in facilitating the realization of these elements in promoting

Fig. 3. Key Ingredients for the Success of C2C.

local climate and disaster resilience through C2C is briefly analyzed in the following sections (Fig. 3).

Commitment to Link

As a network of local authorities, CITYNET provides a legitimate platform for cities to engage in C2C. The local governments' initial commitment to link can be gleaned from their decision to join the Network. Note that their involvement in program activities is based on their own interests, and not on a selection process undertaken by the Secretariat. Their intention to join the activities is the first commitment they had to express when they submitted their application in response to the "Calls for Participation" issued by the Secretariat. The application indicated their expression of interest and assurance to meet the requirements set in the program prior to the implementation. Further commitment to link is expressed when local governments decide to enter into more intensive C2C through the signing of a Memorandum of Cooperation (MOC). As an intermediary to ensure commitment among the partner cities, CITYNET also facilitates and monitors the adoption of action plans and evaluates the progress of implementation. The outputs and outcomes of C2C activities are reported

Box 1. Ensuring C2C commitment in rebuilding Banda Aceh.

The cooperation between Yokohama and Banda Aceh started in the aftermath of the 2004 Indian Ocean tsunami. In 2005 and 2006, Yokohama dispatched experts to Banda Aceh to provide technical assistance in water planning and management, in addition to donation of two water pipe leakage detectors. This was supplemented by Banda Aceh's participation in the CITYNET/Yokohama annual training program on waterworks in September 2006. As a result of these initial interactions, a MOC was signed between the two cities covering the period, January 2007–December 2008, to further strengthen the capacity of Banda Aceh in managing and operating its water supply, which is one of the city's critical concerns in the recovery process, and ultimately enhance the cooperative relationship between Yokohama and Banda Aceh for the benefit of the entire community in both cities. The cooperation assured Banda Aceh's continued participation in Yokohama's training program, which basically entails the transfer of technical skills and knowledge in the management of transmission pipes, maintenance of purification plants, leakage management, among others. To optimize the transfer, CITYNET and Yokohama also committed to dispatch experts to Banda Aceh under CITYNET's technical advisory services, subject to availability of funds. To enhance the cities' commitment to the partnership, ownership of the process was designed in such a way that the detailed aspects of cooperation were to be jointly developed by the participating cities and CITYNET, based on the demands and needs of Banda Aceh.

regularly to the CITYNET's governing bodies, namely, the Executive Committee and the General Council (Box 1).

Community-Wide Participation

The structure of CITYNET's membership provides a conducive environment for interactive participation between local governments and NGOs/CBOs. C2C between cities is strengthened by complementary support from CITYNET's Associate Members, as well as by other actors in the region

(e.g., development agencies, academe, and other city networks). For instance, the activities of CITYNET in Banda Aceh, Galle, Moratuwa, and Muzaffarabad were all done through its NGOs' members, namely, the Urban and Regional Development Institute (URDI) (for Banda Aceh), Human & Environment Links Progressive Organization (HELP-O) (for Galle), SEVANATHA-Urban Resource Centre (for Moratuwa), and Pakistan Institute for Environment Development Action Research (PIEDAR) (for Muzaffarabad). As a prerequisite in undertaking CITYNET's activities, these NGOs (associate members) were able to connect directly with the affected local governments. In relation to the implementation of the CDRI program, which places importance on community participation, Makati City, with support from CITYNET, has been able to engage the community through its *barangays* and other stakeholders in assessing their CDRI level and developing their action plans. Compared to the CDRI of other participating cities, the involvement of Makati, particularly in the Disaster Cluster, was observed to be much more substantial.

Understanding

Depending on the nature of the project or program, understanding the objectives program is usually conducted in the early stages of planning and development. Whenever members proposed the activities through its Cluster's system, this allows them to get familiar with and gain proper understanding of the objectives and expected outcomes/outputs. Meanwhile, when CITYNET members pursue C2C with other members, mutual understanding of the cooperation terms is reflected in the form of a MOC.

Reciprocity

The concept of reciprocity can be applied in C2C, whether it is bilateral or multilateral in nature. However, this is particularly difficult to ensure in the case of South–South cooperation where there are few resources to share. The C2C between Yokohama and Banda Aceh on rehabilitation and reconstruction of Banda Aceh (after the tsunami), a North–South C2C type, may not provide a good balance of reciprocity in both cities. However, even if Banda Aceh benefited more from the cooperation agreement, it did not mean that Yokohama City being the resource city did not gain any benefit from the cooperation at all. Yokohama officials dispatched to Banda Aceh have expressed positive feedback on their experience as part of the cooperation. In a Public Forum held in Yokohama in 2006, one of the

experts dispatched from Yokohama highlighted that his trip to Banda Aceh was an important learning experience in the sense that it instilled in him the importance of working closely with the community.

Result through Real Example

Examples from other cities, particularly from Japanese cities, have inspired others to apply similar approaches in their own territories. For example, Yokohama's vast experience in predisaster planning has been a model for disaster mitigation in other member cities. Recent disasters in the Philippines (Ketsana) have also tested Makati City regarding the effectiveness of its disaster resilience policies, strategies, and activities. As a third party in C2C, CITYNET is responsible for monitoring and evaluating the outcomes and impacts of the cooperation agreement, ensuring that tangible outputs are somehow felt on the ground.

Political Support from Higher Levels of Government

This element was not visible in the implementation of climate and disaster resilience in local governments so far. The nature of CITYNET as a network provides few opportunities for engaging with provincial and national governments. To date, CITYNET's engagement with higher levels of government has been limited to C2C cooperation project on environmental education supported by JICA.

Consistent Leadership

This element was considerably important for CITYNET in facilitating the building of disaster-resilient cities. All cities who participated in the climate and disaster resilience program have had their leaders commit to the mission/vision of the Network when they signed the charter of membership of CITYNET. The role played by the president of CITYNET also assisted in reshaping the direction of CITYNET in building resilient cities in Asia and the Pacific region. Furthermore, the leadership of mayor of Makati as co-chair of the Disaster Cluster raised the commitment of his city. Together with Yokohama City, Makati City has been nominated as one of the champion cities for resilient city under UNISDR's campaign.

Cost-Sharing and Cost Effectiveness

This was the vital element in the nature of cooperation built by CITYNET in order to ensure commitment of its members. In every program, cost sharing and cost effectiveness are expected, wherein cities have to allocate some of their own resources to participate in projects/programs and, more importantly, to fund their plan of actions. In the case of C2C, CITYNET normally covers the costs of travels from beneficiary to resource cities or vice versa. In the case of the Banda Aceh–Yokohama C2C, Yokohama committed to providing modest accommodation and meals for Banda Aceh staff while in Japan (for the training), while CITYNET shoulders the most direct round-trip economy class air travel to Yokohama.

Free Flow of Information

CITYNET facilitates the flow of information among its members involved in C2C using all communication means possible, such as telephones/faxes, Internet, website, Skype, and so on. It coordinates the exchange of information, including relevant documentation, throughout the cooperation process.

ISSUES AND CHALLENGES

CITYNET functions as a facilitating tool for C2C and provides knowledge sharing/clearing house, capacity building/development, as well as policy advocacy. However, as most of its members are from small- and medium-size cities of developing countries (Fig. 4), limited funding impedes the maximization of C2C in all member cities and in ensuring that much wider impacts happen on the ground. CITYNET has advocated for the potential role of C2C in urban development by launching the EC-funded PRO-ACT project in 2006, which not only enabled the connection of cities from Europe and Asia but also linked them with donor agencies in the process. Unfortunately, however, some donor agencies are still skeptical on the tangible benefits of C2C. Furthermore, the involvement of private companies in C2C has yet to be thoroughly explored. Although there is the emergence of such cooperation, for example, the C2C between Jakarta, Seoul, and Palembang on public transport reform, its pros and cons are yet to be optimized and evaluated systematically.

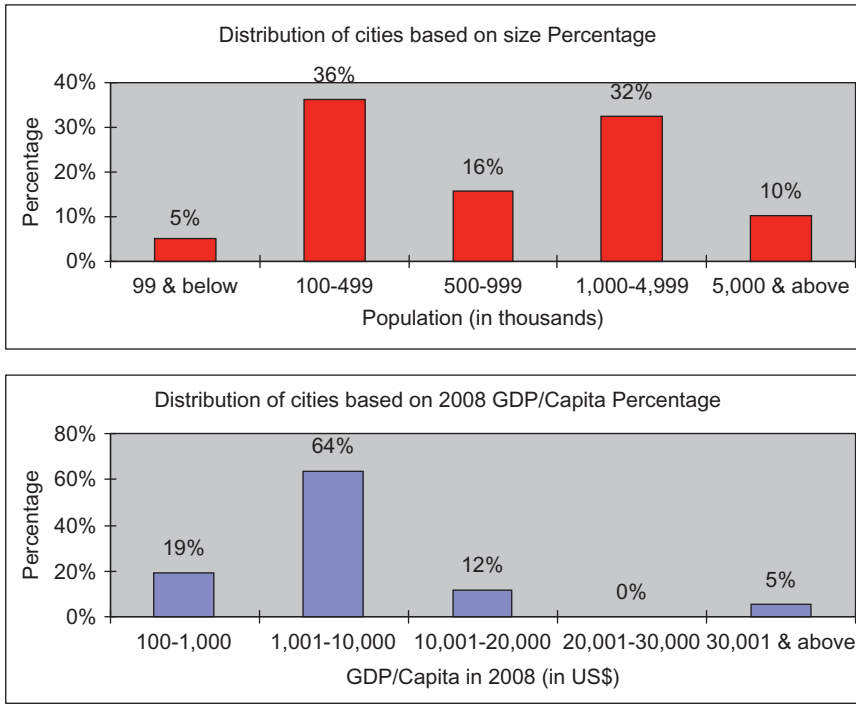

Fig. 4. Distribution of Cities based on Size and GDP/Capita.

Continuous evaluation of projects/programs by city networks was also stated as the challenge and limitation in C2C (Ishinabe, 2010). This has it made difficult to measure the level of policy diffusion of projects/programs. Even though CITYNET conducts project evaluation, there is still much room for improvement to enable the Network to measure the impacts of C2C.

In summary, this chapter has demonstrated how a city network can help facilitate the building of disaster and climate resilient cities through C2C. As a case study, it presented CITYNET's experience in working with local governments in the Asia-Pacific region in the area of disaster risk reduction and climate change adaptation. It has also shown how international development agencies and the academe have contributed significantly in reshaping CITYNET's strategies and approaches, especially with regard to assessing the level of development and preparedness of Asian cities on their resilience to climate change.

The role of CITYNET as an important facilitator of C2C has been viewed from the perspective of critical elements identified in previous studies, namely, (1) commitment to link, (2) community-wide participation, (3) understanding, (4) reciprocity, (5) result through real examples, (6) political support from higher levels of government, (7) consistent leadership, (8) cost sharing and cost effectiveness, and (9) free flows of information (Tjandradewi et al., 2006; Tjandradewi & Marcotullio, 2009). While C2C appears to be a viable option for Asia, and that city networks such as CITYNET stand to be in the best position to support and promote its implementation, CITYNET's experience points to problems of funding and immature monitoring and evaluation mechanisms as primary areas of concern.

NOTES

1. For a preliminary differentiation of the various forms by which municipalities cooperate with each other internationally, see Berse and Asami (2010).
2. The CDIA was established in February 2007 and is cofunded by ADB, German Federal Ministry for Economic Cooperation and Development, and the Swedish and Spanish Governments to assist Asian cities to bridge the planning–infrastructure investment gap.
3. IULA merged with the United Towns Organizations (UTO) and Metropolis in 2004 to form the United Cities and Local Governments (UCLG), the largest organization of municipalities "representing" cities in the United Nations.
4. For example, CITYNET facilitates the formulation of local MDGs city profiles and action plans through its C2C program.
5. In the area of disaster risk reduction, see, for example, Bendimerad, Fernandez, and Reyes (2008) and Berse and Reyes (2007).
6. CITYNET is governed through a General Council, which meets every four years, while day-to-day operations are handled by a Secretariat currently based in Yokohama. See Tjandradewi and Marcotullio (2009) and Hosaka (1993) for a more detailed description of CITYNET's history, membership, organizational structure, and activities.
7. The Asia Regional Task Force on Urban Risk Reduction (RTF-URR) was formed in January 2008 as a platform for collective information and knowledge development and sharing, and to facilitate interactions and cooperation among related organizations and stakeholders. It is coordinated by UNISDR Hyogo Office in Kobe.
8. Aside from CITYNET and UCLG, PURR is also supported by Metropolis, ICLEI, and EMI.
9. Participating cities were Colombo, Hue, Sukabumi, Dhaka, Suwon, Makati, Danang, Chennai, and Kuala Lumpur.
10. The C2C activity between Makati and Kathmandu was part of EMI's larger project with the German Federal Foreign Office through the German Disaster Reduction Committee. CITYNET has also extended its support to this cooperation as both cities, Makati and Katmandu, are members of the Network.

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CHAPTER 12

URBAN FLOOD RISK COMMUNICATION FOR CITIES

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INTRODUCTION

The fact that the world is becoming increasingly urbanized is recognized by the United Nations (UNFPA, 2007) in the State of the World Population Report as the "The Urban Millennium." In year 1950, 30% of the world's population lived in cities and as of recently, the population has reached up to 50%, making year 2007 a turning point in the history of urban population growth (Bigio, 2003; Kreimer, Arnold, & Caitlin, 2003; UN-HABITAT, 2007). By year 2030, the United Nations expects more than 60% of population to be living in cities (Munich Re, 2005). And as shown by Surjan and Shaw (2009), by year 2050, the world's urban population is expected to grow by 3 billion people. Most of this growth will take place in developing countries, with the urban population in cities and towns doubling. As it has been summarized, from 1991 to 2005, more than 3.5 billion people were affected by disasters; more than 950,000 people have taken their lives unwillingly and damages have reached nearly 1,193 billion US dollars. Developing countries will suffer the most from climate change, since they are disproportionally affected and have intrinsic vulnerabilities to hazards and so far have struggled in increasing the capacity for risk reduction measures (Wahlström, 2009). Nevertheless, by contrast, even in the largest and wealthiest countries, which have diversified economies and

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risk transfer mechanisms, the loss has topped an amount of billions of US dollars, as was the case with Hurricane Katrina in USA in 2005. It has been confirmed with facts over the last two decades (1988–2007) that 76% of all disaster events were hydrological, meteorological, or climatological in nature, whether it occurred in urban or in rural areas.

Urban areas offer income and employment opportunities that attract the younger generation, thus leading to socioeconomic development. When a climate-related disaster occurs, such as flood, the socioeconomic well being of urban areas is compromised. One of many important issues that denote the climate change vulnerability and its adaptation is urbanization. Urban areas are characterized by high-density population, which results in higher exposures, and the combination of high vulnerability and exposure causes higher degree of urban risk. Seeing from the natural phenomenon context, although heavy intensity rainfall is a principal cause of urban floods and the heavy rainfall events are normal phenomenon in India during southwest monsoon season in most of the cities, the urban floods have been more visible in recent years (Apte, 2009). The main reason for that is human intervention. As cities started growing uncontrolled, the land use pattern changed drastically with more areas becoming impervious due to constructions and rapid developments, which resulted in change of urban hydrology from gradual rising discharge to quicker and higher peak flow. The sharp peak discharge many a time crosses the inadequate drainage capacity of cities, which leads to stagnation of water on roads and open areas and causes urban flood. Additionally, from urban setting and urban planning context, it shows that the tendency of cities to be located and expanded on the river banks or coastal areas for economic reasons makes them more vulnerable to flood disasters. As example, the form and structure of informal settlements can vary from one urban context to another; however, they remain "illegal constructions." In the urban megacities in Asia, such as Manila, Mumbai, and Jakarta, almost 25–30% of the population lives in these informal settlements, and are exposed to different types of disasters like flood and typhoons (Surjan & Shaw, 2009). The major cities in Asia are either located in the floodplain or in the coastal areas. A recent study (McGranahan, Balk, & Anderson, 2007) shows that nations with largest urban population in the low elevation coastal zone (LECZ) are China, India, Indonesia, and Japan. To sum up, the natural, human, and socioeconomic contexts are contributing to the degree of flood risk in urban areas. To better understand the risk of urban flood, its impacts on urban environment, and its relevance in the urban context, detailed causes of the flood in urban areas are described in the following section.

CAUSES OF URBAN FLOOD

In this section, the major causes of flood in urban areas from the human, natural, and governance perspective are described as the "main drivers" of the type of such flood. Table 1 provides a summary of these causes.

Human Cause

Urbanization has led to an increase in economic and social wealth in some places, but also continuing poverty in others (United Nations, 2006 in Zevenbergen, Verbeek, Gernosius, & Van Herk, 2008). The total urban population is expected to double from 2 to 4 billion over the next 30–35 years. An unwanted side effect of this process of rapid urbanization is the increased susceptibility toward flooding as the result of the concentration of people and assets in flood-prone areas – many urbanized areas are located along major water bodies. In addition, due to the rapid development of urbanization, the cities inhabit huge numbers of residents, even exceeding the total number of population to which they are capable of providing the same services as previous years. Rubbish and debris as product of wastes

Table 1. Key Causes of Urban Flood.

Key Cause	Characteristics
Human cause	Rapid urbanization: • Concentration of people and assets in flood-prone areas • Wastes tend to clog the drainage facilities, reducing the drainage capacity and leading to increased surface runoff
Natural cause	Sea level rise: • Higher sea levels and storm surges Rainfall intensity: • Prolongation of heavier rainfall than in the past Increased glacial melt: • Changes that increase river flows
Governance cause	Inadequate urban planning: • Uneven spatial distribution of urban population

tend to clog the drainage facilities, thus reducing the drainage capacity and leading to increased surface runoff and backup effects and causing the flood (local flood). Many urban drainage facilities are not in good condition due to lack of cleaning and maintenance (WMO/GWP, 2008).

Natural Cause

Climate change may cause flood to occur more frequently and severely. This combination is likely to result in substantially larger flood impacts compared with former times, in which the society and environmental change drivers developed more slowly and the societies continuously adapted to environmental changes (Zevenbergen et al., 2008). Climate change has the potential to increase flooding risks in cities in three ways: from the sea (higher sea levels and storm surges); from rainfall – for instance by heavier rainfall that is more prolonged than in the past; and from changes that increase river flow – for instance through increased glacial melt (Satterthwaite, Huq, Pelling, Reid, & Lonkao, 2007). In addition, sea level rise increases the risk of coastal floods. Many millions more people are projected to be flooded every year due to sea level rise by the 2080s. Those densely populated low-lying areas where adaptive capacity is relatively low are especially at risk (IPCC, 2008 in WMO/GWP, 2008). As the aforementioned statements indicate, climate change also works in an indirect way to aggravate the urban flood. An important notion is given by Zevenbergen et al. (2008) that the current protection measures are based on accumulated knowledge of past weather events. Major disasters have created the need to shift from flood protection to a more integrated approach. In the last decade, however, climate change has been recognized as a potential trend breaker, in the way that hydrological variables and existing statistical distributions of flood probabilities are affected (Kabat, Vierssen, Veraart, Vellinga, & Aerts, 2005; EEA, 2005 in Zevenbergen et al., 2008).

Governance Cause

This cause could also be termed "inadequate urban planning" (Bhagat, Guha, & Chattopadhyay, 2006; Zevenbergen et al., 2008). Although on paper all cities have some kind of development plan, the actual development plan follows no particular pattern except that dictated by expediency, patronage, and privilege. Zevenbergen et al. (2008) recall a research carried out by Sheppard and his team (Angel, Sheppard, & Civco, 2005; Sheppard, 2007). They are one of the first to examine the dynamics and underlying processes of global urban expansion. The results of that study presented

important relevant information on built-up areas of the cities and their changes over time and revealed that the spatial distribution of urban population in nearly all 90 cities surveyed is by and large not the result of conscientious planning. Thus, one of the key messages is that cities and all regions must plan early and much more carefully to accommodate and disperse the impact of over concentrations of people and economic activities in order to avoid large-scale catastrophes. The lack of planning, or even uncontrolled urbanization, will exacerbate the trend of increasing flood vulnerability, known as urban flood. The contributing factors like ''greenfield'' development in areas previously in nonurban use are leading to encroachment and expansion onto flood-prone areas, such as floodplains and lowlands. In addition, redevelopment of built-up areas (''brownfields'') and ''infill'' of the remaining open spaces in already built-up areas are also leading to an overall density increase and subsequent increase of surface sealing and disruption of natural drainage channels.

NEED OF URBAN FLOOD RISK INFORMATION

After knowing the causes of flood in urban areas (Table 1), the question then arises as to how to reverse this trend of increasing flood vulnerability. It requires an understanding of how cities grow and what will be the impact of autonomous growth on their susceptibility to floods. Accelerated urbanization in the last two decades is a major development that has caused climate transformation in many countries. The South East Asia Study for Climate Change Adaptation conducted by Resurreccion, Sajor, and Fajber (2008) shows that urbanization plays a significant role in adapting to the climate change. Since the 1970s, a shift to urbanized living has become a major trend in many Southeast Asian countries. Urbanization, including peri-urbanization, is undoubtedly the immediate development future of most countries of Southeast Asia in the current and next decades. These peri-urban areas have the weakest local government administrative structures and authorities due to a lack of effective jurisdiction by conventional government arrangements. These factors give a distinct dimension to the social vulnerability of people in these places. Since local authorities have mandate and legal aspects background, it is crucial for them to pick up the lead and convey the flood risk information to the communities through risk communication.

Risk communication is ''an interactive process of exchanging of information and opinion among individuals, groups, and institutions,'' as defined by the Society of Risk (US Public Health Service, 1995 in Adler

& Kranowitz, 2005). It often involves multiple messages related to the types and levels of the risk, or to concerns, opinion, or reactions to risk messages, or to legal or institutional arrangements for risk management. A working definition of risk communication is done when the public is informed of potential risks and benefits of specific projects and programs. The National Research Council (1983) summarized that disaster risk communication is actually a creation of a platform to enable stakeholder participation in all processes of the risk analysis cycle to support stakeholders understand the rationale behind risk assessment results and management options. And by that they can make better informed choices in an uncertain and complex situation. The field of risk assessment and risk management has advanced considerably in the past few decades. It has been found that the manner in which the community was informed of the associated risk before, during, and after the event can directly affect whether the event is perceived as being handled successfully or not. Risk communication and its application is becoming widespread (Maher, 2006).

The need for such urban flood risk information at the local scale is one of the central issues, especially for urban development planning. Such information is necessary in order to assess the impacts of urban floods on human and natural systems and to develop suitable adaptation and mitigation strategies at the local level. The end-user and policy-making communities have long sought reliable local scale projections as well as strategies in order to provide a solid basis for guiding the response options, especially for the flood threats in urban areas. This chapter identifies the factors influencing the extent of urban flood risk, challenges, and some mitigation in several urban areas in Asia. Since it is essential for enabling the development of better preparedness and more resilience among urban communities, this chapter also addresses the role of local government in organizational capacity and its commitment in addressing the risk and conveying the information to the wider public.

CHARACTERIZING URBAN FLOODS

In terms of economic losses both direct and indirect, floods in urban areas have large impacts. The study done by WMO/GWP (2008) showed that flood risks are a function of exposure of the people and the economic structure along with the vulnerability of social and economic fabric. As such the impact of such floods on the lives and livelihood of people, a function of their vulnerability, needs to be understood. WMO/GWP (2008) identifies the following

characteristics that have relevance to the increased flood risks in low and middle income countries: concentrated population; large impermeable surfaces and construction of buildings; concentration of solid and liquid wastes due to inappropriate disposal systems; obstructed drainage systems; intensive economic activities; high value of infrastructure and properties; rise of informal settlements; housing with low hygiene standards; and lack of change in regions around cities. These are root causes that contribute to the risks due to growing suburbs and the mushrooming of peri-urban areas. The extended understanding of the risk is the probability of a loss and it depends on three elements: hazard, vulnerability, and exposure. If any of these three elements increases or decreases, then the risk increases or decreases (Crichton, 1999). In the context of floods, UNISDR (2009) mentioned exposure refers only to the question whether people or assets are physically in the path of floodwaters or not and vulnerability may be defined as the characteristics and circumstances of a community, system, or asset. It is susceptible to the damaging effects or impact of a flood. In case of hazardous events, access to such entitlements could enable a person or a group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard (Wisner, Blaikie, Cannon, & Davis, 2004).

In summary, to understand the flood risks in urban area, it is important to first be familiar with the different components that construct the risks of the flood. A component in the creation of risk is the fact that somebody or something is vulnerable to a hazard. Vulnerabilities, like exposure, should not be considered only as given unsafe conditions but as the result of different processes, which finally make people and their belongings more or less susceptible to the impact of flood hazard. Among the root causes of these processes, socioeconomic factors are the driving forces, including access to or exclusion from education, medical facilities, economic opportunities, political participation, and the use of natural resources. And those entitlements usually depend on the sociocultural background of people in terms of class, ethnic origin, gender, and religion (Wisner et al., 2004; WMO/GWP, 2008).

TYPOLOGY OF URBAN FLOODS

The above-mentioned components such as exposure and vulnerability could be labeled as the crucial issues that contribute to the urban type of flood. Basically, WMO/GWP (2008) has divided the types of urban floods into four categories. Regardless to that, flood in urban areas can be attributed to one or a combination of the below-mentioned types. For managing the

urban floods and subsequently transfer and convey that information to the public at large (communities) by the local authorities (local government), it is essential to understand the causes and impacts of each one of them.

Coastal Floods

High tides and storm surges caused by tropical depressions and cyclones can cause this type of floods in urban areas that are located at estuaries, tidal flats, and low-lying land near the sea in general. Coastline configurations, offshore water depth, and estuary shape influence the intensity of coastal floods. High tides may impede the discharge of rivers and drainage systems, leading to local or riverine floods. Tidal effects in the estuarine reaches keep the river levels high for long periods of time and sustain flooding. Thus, the cities located in estuarine reaches have to bear the combined impacts of riverine as well as coastal floods due to storm surges and tidal effects. Coastal areas are exposed to sea erosion, which is particularly likely with the increase in the sea roughness due to climate change.

Flash Floods

Flash floods occur as a result of the rapid accumulation and release of runoff waters from upstream mountainous areas, which can be caused by very heavy rainfall, cloud bursts, landslides, the sudden break-up of an ice jam, or failure of flood control works. They are characterized by a sharp rise followed by relatively rapid recession causing high flow velocities. The discharges quickly reach a maximum and diminish almost as rapidly. These are particularly common in mountainous areas and desert regions but are a potential threat in any area where the terrain is steep, surface runoff rates are high, streams flow in narrow canyons, and severe thunderstorms prevail. In more densely populated areas, they are more destructive than other types of flooding due to their unpredictable nature and unusually strong currents carrying large concentrations of sediment and debris, giving little or no time for communities living in its path to prepare for it and causing major destruction to infrastructure, humans, and whatever else stands in their way.

Local Floods/Inundation Floods

Saturated and impervious soil is exacerbated by seasonal storms and depressions during the rainy season with very high intensity and long duration

rainfall. Built environments like cities generate higher surface runoff that is in excess of local drainage capacity, causing local floods. Urbanization leads to decreased rate of infiltration and increased surface runoff. Many urban drainage facilities are in bad shape due to lack of cleaning and maintenance. Wastes tend to clog the bottlenecks of drainage facilities, leading to increased surface runoff and backup effects, causing local floods. In small and medium towns and cities, the rapid development and the consequent infrastructure such as road building fail to account for the natural drainage systems without providing for cross-drainage works. Depending on the local hydrogeological situation, rising groundwater or subsurface flows can be other causes that lead to local floods. They are generally confined to rather small geographical areas and are normally not of long duration. However, in regions of extended rainy seasons (monsoon climates), local floods may last for weeks, resulting in widespread destruction.

Riverine Floods

River floods occur when the river runoff volume exceeds local flow capacities. River floods are triggered by heavy rainfall or snow melt in upstream areas, or by tidal influence from the downstream. The river levels rise slowly and the period of rise and fall is particularly long, lasting a few weeks or even months, especially in areas with flat slopes and deltaic areas. Failure or bad operation of drainage or flood control works upstream can also sometimes lead to riverine flooding. Urban areas situated on the low-lying areas in the middle or lower reaches of rivers are particularly exposed to extensive riverine floods. In most major river basins, floodplains are subjected to annual flooding. Often, urban growth expands over some of the floodplains, reducing the area into which floods can naturally overflow. A risk might exist for lower city parts, in case the artificial levees breached, causing devastating urban flooding.

After the causes as well as the typology of urban floods are identified, the differences of each urban flood type are described in Table 2. The following section will briefly summarize the impacts of urban floods.

IMPACTS OF URBAN FLOODS

As it has been mentioned at the beginning of the previous section, the impact of urban floods on the lives and livelihoods of people (exposure) as

Table 2. Differences of Urban Floods.

Typology of Floods	Characteristics
Coastal floods	• High tides and storm surges caused by tropical depressions and cyclones • Coastline configurations, offshore water depth, and estuary shape influence intensity of coastal floods • High tide impede the discharge of rivers and drainage systems • Tidal effects in the estuarine reaches keep the river levels high for long periods of time and sustain flooding • Coastal areas are exposed to sea erosion, particularly likely with the increase in the sea roughness due to climate change
Flash floods	• Rapid accumulation and release of runoff waters from upstream mountainous areas • Sharp rise followed by relatively rapid recession causing high flow velocities. Discharge quickly, reach a maximum, and diminish rapidly • In mountainous areas and desert regions but a threat in steeply terrain area, high surface runoff rates, streams flow in narrow canyons, and severe thunderstorms prevail • In densely populated areas, more destructive than other types of flooding
Local floods/ inundation floods	• During rainy season, very high rainfall intensity and long durations, sometimes caused by seasonal storms and depressions and exacerbated by saturated or impervious soil • Built environments generate higher surface runoff that is in excess of local drainage capacity, adding up bad condition of urban drainage facilities; wastes clog the bottlenecks of drainage facilities, leading to increased surface runoff and back up effects • Groundwater rising, depending on the local hydrogeological situation or subsurface flows • Generally confined to rather small geographical areas and are normally not of long duration. In small and medium towns and cities, rapid development and the consequent infrastructure fail to account for the natural drainage systems without providing for cross-drainage works
Riverine floods	• Occur when the river runoff volume exceeds local flow capacities • Triggered by heavy rainfall or snow melt in upstream areas, or tidal influence from the downstream • Failure or bad operation of drainage or flood control works upstream. In parts of the city below flood level and protected by artificial levees, risk that it may be breached and cause devastating urban flooding exists • Exposing urban areas situated on the low-lying areas in the middle or lower reaches of rivers, in most major river basins and floodplains

well as a function of their vulnerability needs to be appraised (WMO/GWP, 2008). Therefore, these issues are influential for the local government to enabling them in the decision making process as well as setting up strategies for flood risk communication. The following section describes the exposure and vulnerability of the urban floods.

Exposure

The exposure in the context of the urban floods refers to the probability of whether the people or the assets are in the range of floodwaters. One of the major factors that contributes to rise in urban flood damages is the increasing number of people and infrastructures that are physically exposed to floods in cities. Cities in many developing countries are growing rapidly. Unprecedented migration from rural areas to cities has led to uncontrolled urban sprawl with increasing human settlements, industrial growth, and infrastructure development in flood-prone areas. According to UN Department of Economic and Social Affairs (2005), entering year 2007, the global population living in cities exceeded for the first time in history the global rural population, thus introducing "the urban millennium." And for the same study, UN Department of Economic and Social Affairs (2008) mentioned the world population is expected nearly to double by year 2050, increasing from 3.3 billion in 2007 to 6.4 billion in 2050. By mid-century the world urban population will likely be the same size as the world's total population in 2004. Virtually all of the world's population growth will be absorbed by the urban areas of the less developed regions, whose population is projected to increase from 2.4 billion in 2007 to 5.3 billion in 2050. Despite its low level of urbanization, in year 2007 Asia was home to about half of the urban population in the world. Over the next four decades, Africa and Asia will experience a marked increase in their urban populations (Fig. 1). Urban growth need not necessarily lead to the intensification of risks if it takes into account the flood risks in the land use planning processes. The decisive factor is whether urban growth factors of flood risks integrated in the development process or not. Many times the commitment to flood risk sensitive urban planning depends strongly on the flood frequency. After years or decades without major flood events, it becomes more and more difficult to maintain the flood awareness of both people and authorities. Often the construction and land use regulations, the underlying legal basis, as well as a set of concrete plans do exist but are not enforced.

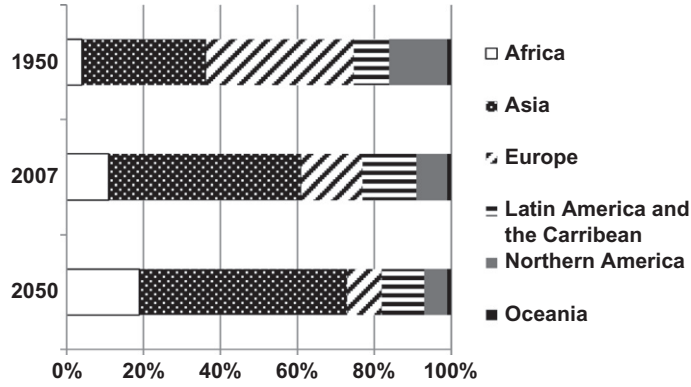

Fig. 1. Adapted from Distribution of World's Urban Population: 1950, 2007, and 2050. *Source:* United Nations Department of Economic and Social Affairs (2008).

Vulnerability

In order to determine whether or not exposure to hazards constitutes a risk that may actually result in a disaster, vulnerability is the most crucial component of risk. Many vulnerable factors influence the flood risk in urban areas; this chapter has depicted only three types of vulnerability, in terms of avoiding a flooding event turning into disaster at societal as well as at individual level (WMO, 2008).

Physical Vulnerability of People and Infrastructure

Urban development inherently creates larger risks, but those in higher income groups are able to avoid or bear such risks, while those with low incomes cope with them to their detriment. Other factors aggravate this spatial marginalization. The flood-prone areas are often not privately owned, and thus informal dwellers are less likely to get displaced. Additionally, many urban poor are migrants from rural areas who are not familiar with the respective hazards and therefore tend to underestimate the risk of living in such exposed areas. Briefly, the vulnerability to flood risks in urban settlements, particularly in informal developments of developing countries, can be attributed to the following factors: risk-prone areas are the only areas that the poor migrants are able to afford; they fail to perceive flood risks due to lack of knowledge until a flood strikes; infrastructure to

reduce risk is not economically viable; and flooding occurs regularly so they become accustomed to living with the flood risks.

Unfavorable Organizational and Economic Conditions
Informal settlement dwellers are unable to act effectively together. In any case, mutual support among community members is crucial for coping with stress situations. Such informal social networks are often the only "insurance" of the poor and are particularly important if official support is weak. Unfortunately, it belongs to the characteristics of urban poverty that social networks tend to be weaker in cities than in villages. Livelihoods of people living in informal settlements are dependent on their daily earning capacities, which are severely affected by flooding. However, for those who have regular sources of livelihood, their incomes are not disrupted by floods. Economic vulnerability prevails obviously among those households that lack financial resources and those who cannot afford.

Attitudes and Motivations
Reluctance toward flood preparedness and mitigation measures may be the result of lacking hazard knowledge or of fatalistic attitudes. Out-migration may lead to the erosion of local knowledge that might serve to prevent disasters and a loss of the skills required for coping in the aftermath of a disaster (Wisner et al., 2004). Additionally, dependence on too much external support can reduce the individual responsibility to deal with problems in a proactive manner.

CASE EXAMPLES OF URBAN FLOODS

In order to have a broader understanding of the relevance of flood risk communication in urban areas, several case examples from Asian cities are depicted in the following sections. These case examples are selected and categorized according to the characteristics of different types and combination of urban floods occurring in their regions. The categorization is shown in Table 3.

Case of India

Mumbai, as one of the megacities in India, was the worst hit by floods in July 2005. Surprisingly, downpour of 944 mm rain lasted for 24 h and forced

Table 3. Category of Urban Floods Types for the Case Examples.

Case Examples	Types of Urban Floods
India: Mumbai	Flash flood and inundation flood
Indonesia:	
Jakarta	Flash flood and inundation flood
Semarang	Coastal flood and flash flood
Japan: Nagoya	Riverine flood and inundation flood
Taiwan: Taipei	Flash flood
Vietnam: Hanoi	Flash flood and inundation flood

the city to a standstill (Kelkar, 2005; ENVIS, 2008; Bhagat, 2006; Surjan, 2008). In the afternoon of July 26th, 2005, Mumbai City, the suburban and the entire region, was struck with a heavy storm. The impact was immense – thousands of people had to wade through water with a depth ranging from the knee to the neck level. People were caught off guard and they were stranded for many hours. The operation of roads and railway lines infrastructure came to a halt as at many places they were under water. The suburban trains, normally running at intervals of 3 min, were also affected, and 150,000 commuters including the school children got instantly stranded at railway stations. The airport was closed and electric supply for many areas was cut off for several days (Kelkar, 2005). The financial effect of the flood was unprecedented and caused a stoppage of the entire commercial, trading, and industrial activities for days. Preliminary indications showed that the flood caused a direct loss of about Rs. 450 crores (equal to 100 million USD) (UNESCAP, 2009). It had huge effect on the Bombay Stock Exchange and the National Stock Exchange of India as well as the banking transactions across the counters. Many branches and commercial establishments were unable to function from late evening of July 26th, 2005. In the aftermath, the state government had declared the 27th (and later, 28th) of July as a public holiday. The issues that had been the cause of the Mumbai flooding are related to the following two major problems:

1. *The uncontrolled urbanization of north Mumbai and the destruction of mangroves:* The built-up area of Mumbai has increased, mainly expanding along transport corridor with improved connectivity. Simultaneously, the increased concretization has drastically reduced the green zones and open spaces, which are effective carbon sinks and dust filters

that help to keep down pollution levels (Srivastava & Mukherjee, 2005 in Bhagat, 2006). Although the central forested area has helped to preserve some of the forest cover within the city, the opening up of large area for construction has led to the peripheral areas becoming degraded into scrublands (Bhagat, 2006). Additional urban activities' contributions are encroachment that led to narrowing of banks, reclamation of river beds for housing, unauthorized slum development, construction of industrial units, and diversion of river flow due to dumping of construction debris and solid wastes by stables and cottage industries on the banks of the rivers. The mangroves around Mumbai, which act as the city's sponges and support the ecosystem, had shrunk from 235 to 160 km^2 in year 1994 and an additional 1,000 ha were destroyed by the year 2000 and much of them had be done by violating the rules. Wetlands and forest are used to cover the land use in Mumbai (Sekhar, 2005 in Bhagat, 2006).

2. *The inadequacy of the existing drainage system:* According to UNESCAP (2009), the existing storm-water drainage system in Mumbai was put in place in the early 20th century and is capable of carrying only 25 mm of water per hour, which was extremely inadequate on a day when 944 mm rain fell in the city. The drainage system is also clogged at several places. Only three outfalls are equipped with floodgates, whereas the remaining 102 open directly into the sea.

To summarize, the haphazard growth, unprecedented rains, and the failure of the early warning system together created the situation during Mumbai flood of 2005 (Bhagat, 2006).

Case of Indonesia: Jakarta

In late January 2002, excessive monsoonal rains hit West Java, and the subsequent floods crippled the city for days, with thousands of houses submerged, 300,000 people homeless, and 30 people killed (Steinberg, 2007). In February 2007, an even bigger flood affected 60% of the city region, killing 80 people – either from drowning or from electrocution – forcing 430,000 residents out from their homes, and leaving thousands of homes totally destroyed; most of the people were accommodated in 700 temporary shelters in different places such as schools, mosques, office buildings, tents, and other neighborhoods. In large parts of the city, electricity and telecommunication services were disconnected (IFRC, 2007) and a total

loss 1.2 billion USD was estimated (EMI, 2009). According to the city's flood crisis center, the floods affected an estimated 80 districts in Jakarta (WHO, 2007). As floodwaters receded after two weeks in February 2007, public was in anger about the lack of flood warning, the inadequacy of emergency assistance, and the failure of long-term planning and civil works. The scope of damage shows how vulnerable are the communities living in Jakarta.

The causes for flooding in Jakarta go beyond the geographical difficulties and are mostly man-made. The main causes are inadequate carrying capacity of flood control infrastructure; reduction in the capacity of existing systems due to uncontrolled garbage dumping; and reduction of rainwater absorption due to urbanization and deforestation. First, the city's flood canal system remains largely incomplete. The Dutch-built Western Flood Canal is not sufficient and the eastern region of the metropolis is clearly affected by the incompletion of the Eastern Flood Canal. Second, there is a reduction in the width of important waterways. For example, the Angke River, which originally was 40–60 m wide, has shrunk to approximately 5–10 m in width as of 2007 data. The government held the riverbank settlers responsible for inappropriate waste dumping because illegal settlers do not have public waste collection services (Steinberg, 2007). Huge amounts of household garbage and industrial waste are emptied into Jakarta's rivers each year, and the fact that this is not cleared by the authorities or the adjacent communities substantially contributes to the increase in the probability of regular flooding.

Third, the reduction of water absorption is due to uncontrolled urbanization in the city suburbs. Among others, the traditional water catchment area of northwest Jakarta, located near the international airport, has been reduced substantially. The reduction is seen among the prime causes of the massive flooding (Steinberg, 2007). In addition, deforestation and new real estate colonies in the neighboring districts have had additional impacts on those areas where majority of rainfall occurs. At the upstream areas, numerous villas have been built as secondary residences in the past 50 years by the upper classes of Jakarta, while a flourishing tea plantation has progressively settled on the main slopes of volcanoes, causing a huge reduction in the forested area (Texier, 2008). Fast and uncontrolled urbanization is thus largely recognized (Texier, 2008) as a major factor that emphasizes flood risk in Jakarta. The impact of the 2007 flood was massive; the loss of life, property, and economic capacity, and health problems have paralyzed the capital city of the fourth largest country in the world.

Case of Indonesia: Semarang

Coastal flooding occurs frequently in many large coastal cities of Indonesia. Coastal flooding will be worse in places where land subsidence occurs. Semarang City is the capital of the province of Central Java, with a population of 1.5 million people, and is currently growing by roughly 2% each year. It has specific problems related to coastal environment. The coastal area of Semarang has been reported to have subsided relative to mean sea level (Sutanta, 2002; Kobayashi, 2003; Marfai & King, 2007a, in Marfai & King, 2007b). The subsidence varies from 2 to 10 cm/year and the maximum rate is about 16 cm/year. It causes damage to infrastructure and inundation on the coastal area with various seawater levels (Marfai, 2004). Numerous communities and infrastructures at the low elevations behind the beach are subjected to rising of seawater tides and inundations. The rapid urbanization in the coastal urban areas with high population concentration has significantly increased the vulnerability. Coastal flooding has been a problem in Semarang, especially wherever development has occurred adjacent to the sea, with complete or limited protection. The coastal flooding also affects the infrastructure such as roads, bridges, and utility lines and brings inundations to the coastal settlements and agricultural lands. Annually, the local government has to spend large amounts of money on their maintenance. The main railway station is subjected to flooding almost every year. The areas around the main station and close to the harbor are almost constantly flooded. The Public Works Department of Semarang (PWD, 2000) recorded that in January 1990 the flood claimed 47 lives, collapsed 25 houses, damaged 126 houses, collapsed 1 school building and 1 dormitory, and affected 145 ha area with up to 3 m depth of inundation for a period of 2–4.5 h.

Nowadays local government in Semarang is employing both structural and nonstructural methods to address the problems related to coastal flooding. The structural methods, such as dyke, coastal-land reclamation, drainage system, pump station, and polder system, have been established in low-lying areas of Semarang. In addition, various sources have mentioned about the implementation of nonstructural measures, such as strengthening disaster management framework, coastal planning and management, as well as public education (PWD, 2000; Dewi, 2007; Marfai & King, 2007b). Although some improvements have been made, the current flood management system has generally failed to address a wide range of coastal inundation problems. A need to share social–community, technical, and technological expertise to deal with flood problems is crucial to address the

issues of concrete action in coastal hazard management (Dewi, 2007; Marfai et al., 2007 in Marfai & King, 2007b).

Case of Japan

During the period of 1957–2000 about 10 important floods occurred in the Syonai River system. One of the major events was generated by the "Tokai heavy rain" in September 2000, as a result of the combined effects of an autumn rain front and a typhoon that affected the whole region. In September 2000, heavy rainfall with 97 mm hourly precipitation out of 567 mm had inundated the city of Nagoya with a total population of 3 million in the Tokai area. This has popularly been called the Tokai Flood Disaster of 2000 (Zhai, Fukuzono, & Ikeda, 2003; WMO/GWP, 2004). The flood was one of the severest ever experienced in Japan, and according to the statistics of the Ministry of Land, Infrastructure and Transport, reported damage amounted to a death toll of 10 people; about 580,000 people had taken refuge; the number of damaged houses in which flooding reached above floor level was 23,896; 39,544 houses had flooding below floor level; and direct economic loss amounted to 978.3 billion Japanese yen (Zhai, Fukuzono, & Ikeda, 2003; WMO/GWP, 2004). The general economic loss caused by the Tokai Flood Disaster of 2000, in which the metropolitan areas of Nagoya were flooded, was the worst in 40 years. At many monitored points in the two rivers, water exceeded the established design levels and signs of possible collapse of banks were observed in many places. The signs are, namely, leakage of water from the bank, overtopping, and partial collapse of the bank. A bank failure occurred together with the already widespread inundation within the protected area and increased the effect and depth of the flooding, which lasted for three days (WMO/GWP, 2004).

The floods in urban areas of Japan have not purely been a natural phenomenon; the social conditions have played an important role. They varied from region to region and from time to time, as observed by Takahasi (1964, 1971) in Sato (2006). Sato (2006) illustrated the structure of modern flood disasters up to the 1960s, just the initial stage of Japanese experience in a period of high economic growth. Another cause of urban flood described is that the volume of flood runoff has increased as a result of the loss of water detention capacity of urban catchments. According to the Japan Meteorological Agency statistics, the number of heavy rainfalls and the primary external force of a flood hazard have been increasing in urban areas and contributing to the increase in floods (Sato, 2006). Another factor that

increases the flood risk is occurring in the floodplains. This factor is land subsidence and is mainly caused by groundwater withdrawal. Additionally, urbanization has led to the deterioration of local community relationships and increased the number of new residents who are unfamiliar with flooding vulnerabilities. Local residents and communities have left their safety in the hands of government (Sato, 2006). Various disaster prevention activities are promoted by local communities in a new social scheme, including coordinating new forms of social networks and utilizing modern communication technologies (Sato, 2006). Lessons learnt from the Tokai Floods of 2000 in Nagoya City have shown that the risk of catastrophic flood disasters has not been eliminated. It should be continued to be considered by the society, as it could finally cause human death and property loss (Ikeda, 2006).

Case of Taiwan

Flood catastrophes in Taiwan have become more frequent and more intensive. According to the historical records from the Ministry of Interior Affairs (MOIA), the floods in the past 25 years have damaged approximately 3,000 buildings, with losses of 518 million USD (Teng, Hsu, Wu, & Chen, 2006). Typhoon Nari that came through the Keelung River caused torrential rainfall on September 17th, 2001. The rainfall intensity in Nankang district, Taipei, had increased from 4 a.m. and the hourly rain amounted to 105 mm at 8 a.m. and 73 mm at 9 a.m. The rainfall that lasted for 12 h had amounted up to 530 mm high. This heavy rainfall and the consequent overflow from the Keelung River caused the inundation of a wide area of Taipei City. The flood caused heavy damages, intruded into substructure space of the rapid transit system, the subway stations, and the basements of buildings and underground shopping malls. According to the Taipei City Government statistics (Teng et al., 2006) , there were 104 casualties or missing persons and a direct loss of more than 20 million USD. In response to that, the Water Resources Agency (WRA) of the Ministry of Economic Affairs (MOEA) had a budget of 10 billion USD for flood defense structures, such as levee construction, dredging, flood diversion, flood detention, and watershed management and drainage improvement. One famous structural works for flood damage reduction is the Taipei Metropolitan Mitigation Project (TMFMP), which includes building the Erchong diversion channel that diverts 6,500 m^3/s upstream floodwater from the 25,000 m^3/s design flow of the Danshuei River. Although the water

authority keeps maintaining the existing flood structures and constructing new ones, the flood damages are growing instead of decreasing. One of the possible reasons is that the structural measures in regions with high flood potential usually mislead the public awareness of flood risk.

Analysis done by Teng et al. (2006) showed that countrywide flood disaster was caused by improper urban development. Due to the increasing migration into the region, the urban area expanded quickly. The inundation potential was not considered in the urban planning. Some buildings occupied the floodplains and increased the flood risks (Ma et al., 1999 in Teng et al., 2006). In addition, high populated and vulnerable areas, with potential natural disasters, have been located in flood-prone areas. The government had been following up the Flood Hazard Mitigation Measures and had appointed Council for Economic Planning and Development (CEPD) for working out the WRA recommendations. The recommendations are flood forecasting, monitoring, emergency measures and planning, environmental concerns, and floodplain management including zoning, legislation, and enforcement. Following these recommendations, 10 major follow-up measures on flood hazards mitigation are described by WRA and ROC (2003) in Teng et al. (2006). One of the important measures that has to be followed up is to simplify and clarify communication between flood forecasters and those with local flood emergency responsibilities (local government), throughout the basin. The dissemination of forecast information to the public through the media should be simple and the variables inherent in those forecasts should be easily understandable.

Case of Vietnam

In November 2008, a major disastrous event took many people of Hanoi City by surprise (IFRC, 2008a, 2008b; Tuan & Duong, 2009). Persistent and prolonged rainfall over the past 72 h had caused widespread flooding in cities and provinces in Vietnam, including Hanoi City (IFRC, 2008a, 2008b; Tuan & Duong, 2009). Heavy rains battered the Hanoi City with falls up to 450 mm in major streets and roads. IFRC (2008a, 2008b) reported on the basis of government information that there were 85 casualties and that 20,000 families were affected. Many markets, schools, and offices had to close. The communications and transport routes in the city had been disrupted due to flood in certain submerged areas; people had to travel by small boats or use some other creative measure to move from place to place

(IFRC, 2008a, 2008b). Many citizens had no access to clean water during that period as flooding had caused power outages and stopped water pumps. Many badly flooded areas had been without electricity for almost a week. The rains submerged 45,000 ha of subsidiary crops and 9,000 ha of aquatic breeding acreage. The Municipal People's Report (Tuan & Duong, 2009) estimated total material losses of VND 3,000 billion (1.6 million USD).

Hanoi has experienced an expansion through controlled suburbanization process, leading to the establishment of settlements in the flood zones outside the cities, called the Riverside Urban Areas (RUA). Subsequently, the human settlements have reduced the river flow, decreased flood discharge capacity, and raised the flood level of the Red River. According to the available data in Hung, Kobayasi, and Shaw (2009), the flood level of the Red River in Hanoi has been raised by about 0.8 m in the past 60 years (1939–2000) with the same water discharge. A rapid rise of 0.6 m was observed in the past 30 years (1970–2000) Uyen, 2002 in Hung et al., 2009). And due to the increasing impact of socioeconomic development, Hanoi has been growing speedily with little attention being paid to the risk of catastrophic flood.

The causes of such a flood are the old and low-capacity underground sewage irrigation systems, which cannot afford to discharge water when rainfall is higher than 100 mm/h. Many ponds and low land areas were replaced by construction and buildings, which led to the reduction of water restoration capacity of the city. Additionally, the boom of urbanization has led to inefficient solid wastes processing, resulting in inundation and stagnation of underground water. Given that the first phase of the Irrigation Project in southern Hanoi is complete, the city still copes with high inundation when rainfall is higher than 100 mm/h. Many roads and streets are heavily inundated, causing traffic jam for hours (World Bank, 2008). The overdevelopment of the RUA in Hanoi city has also contributed to the causes of urban flood. The low perception about urban flood risk among the communities in the RUA has led to the increase of population and house construction in the areas (Hung et al., 2009). The development has continued in the RUA, even after the approval and implementation of Construction Regulation that deals with illegal construction and of Ordinance on Dykes to protect the dykes and regulate the growth of the RUA. The regulation still could not enhance the policy-level preparedness. In the case of RUA, Hanoi's developmental plan conflicts with the goal of disaster management because the development of RUA is happening in the most flood-prone areas of the city (Hung et al., 2009).

UNDERLINE RISK COMMUNICATION FROM CASE EXAMPLES

Reviewing the aforementioned case examples, which are summarized in Table 4, it can be said that the human factors are dominant in explaining the magnitude of flooding episode. Urbanization is partly responsible for the extent of flooding by waterproofing the soils. To prevent the increasing flood vulnerabilities among the urban communities, it is essential to refocus flood risk management strategies on daily pattern and to integrate them with each cities' development framework, in terms of access to resources (public services and economic values such as infrastructure), and to favor for the urban community empowerment.

At the heart of the shortcomings in each case study lies a discrepancy between the policy goals of urban development and urban floods management. It is combined with the low perception of flood risk among residents, reflecting the lack of knowledge base about flood. There has been knowledge about the probability of flood occurrence, for example, in case of RUA in Hanoi. However, such knowledge was incomplete because it did not include estimation or losses from using flood-prone areas (Hung, Shaw, & Kobayashi, 2010). Reflected from several case examples around Asian cities, in order to overcome flood barriers, causes, and reduce the damages, which may arise, a few strategies have to be explored. Hung et al. (2010) proposed one of the strategies that is increasingly in demand: to build and share a knowledge base about the flood risk and seek sustainable ways of coping with the flood in Hanoi. Such knowledge about the flood and the long-term risk among the communities needs to be enhanced for enabling fully informed decisions. The city's authorities as the policy makers and the communities with the participation of experts and local officials need to know not only about the areas subject to the flood but also about the existing or proposed use of vulnerable areas, similar with the condition of illegal settlements in Jakarta.

One of the indispensable information is an acceptable flood risk level for the communities who live in flood-prone areas. It needs to be developed by communities with the participation of experts and local authorities (Hung et al., 2010). Communities should not be passive recipients of information. There is a need to encourage people to help themselves, and communities must be provided with the mechanisms and tools to do so (UN, 2008). Communities need to be active in the information dissemination system and require a technology that is adapted to local needs and conditions. The local authorities should facilitate and empower the community leaders to play a

Table 4. Summary of Case Examples.

Location	Precipitation	Event	Losses	Causes
Mumbai	944 mm	July 2005	• Thousands of people homeless • Stoppage of public transportation system • Stoppage of entire commercial, trading, and industrial activities • Closing of airport and electric supply cutoff • Loss of 100 million USD	• Haphazard growth of the city due to uncontrolled urbanization • Unprecedented rains • Failure of early warning system
Jakarta	750 mm	February 2007	• Inundated 60% of the city and 80 districts • 80 people died, 430,000 homeless, and thousands of homes destroyed • Large part of the city disconnected from electricity and communication services • Loss of 1.2 billion USD	• Lack of carrying capacity of flood control infrastructure • Reduction of capacity of existing systems • Uncontrolled garbage disposal • Reduction of rainwater absorption due to urbanization and deforestation • Lack of warning; failure of long-term planning and civil works; and inadequacy of emergency aid
Semarang	3 m depth of 2–4.5 h duration	January 1990	• 47 people died, 25 houses collapsed, 126 houses damaged, 1 school building and 1 dormitory collapsed • Inundated 145 ha land	• Coastal area subsided relative to mean sea level • Rapid urbanization in the coastal urban areas with high population concentration, especially where development has occurred adjacent to the sea with complete or limited protection
Nagoya	567 mm	September 2000	• 10 people died, 20 people seriously injured • 580,000 people took refuge • More than 63,000 houses were flooded	• Increasing number of heavy rainfalls due to combined effect of autumn rain front and a typhoon

Table 4. (*Continued*).

Location	Precipitation	Event	Losses	Causes
			• Loss of 978.3 billion Japanese Yen	• Bank failure with already widespread inundation within the protected area • Exceeded volume of flood runoff due to loss of water detention capacity of urban catchments • New residents are unfamiliar with flood vulnerabilities in the area due to urbanization
Taipei	530 mm	September 2001	• 104 casualties or missing persons • Heavy damages to rapid transit system, subway stations, basements of buildings, underground malls • Loss of more than 20 million USD	• Heavy rainfall and the consequent overflow from Kelung River • Occupancy of the floodplains and increase in the flood risks due to improper urban development
Hanoi	450 mm	November 2008	• 85 casualties, 20,000 families affected • Markets, schools, and offices were closed. Roads and streets heavily inundated • Stoppage of power and water pumps – no access to clean water and no electricity for a week • Submerged 45,000 ha of subsidiary crops and 9,000 ha of aquatic breeding acreage • Loss of 1.6 million USD	• Old and low-capacity underground sewage irrigation systems unable to discharge water • Ponds and lands replaced by constructions and buildings, reducing the water restoration capacity • Improper disposal of wastes, stagnation of underground water due to urbanization • Overdevelopment of Riverside Urban Areas (RUA) of Hanoi city

key role in the discussions. Information such as flood map and the probability as well as the consequences of flood model should be used with the support of experts. There are also steps needed to ensure that the information is available and understood by the public. The process to execute those steps is positioned under the umbrella of risk communication. Because the manner in which the community was informed of the associated flood risks before, during, and after the flood can directly affect whether the event is perceived as being handled successfully or not (Maher, 2006).

WHY RISK COMMUNICATION IS IMPORTANT FOR CITIES?

When floods occur in urban areas, information must reach the citizens immediately in order to minimize the intensity of the disaster among the affected people. Although the risk communication of urban flood has been successfully implemented in Japan, the flood-prone urban areas are predicted to cope and address the adequate measures as explained in the following scenarios (Ikeda, 2006):

Increased flood damage potential due to urban development and classification: From 1960 to 1980 the local rice paddies, which once acted as a flood-protection belt, were turned into residential and industrial districts. This made the newly ''developed'' areas vulnerable to flood when medium- and small-sized rivers overflowed and the lack of flood-protection belts led to inner urban flooding. Since that time, accelerated economic growth and innovation in all urban sectors have brought rapid increase in the population of Japan's metropolitan area.

Decline in preparedness of local communities to cope with flood disasters: The government evacuates the residents via a public warning system. This approach has ensured the appropriate level of safety, but at the same time, disaster prevention awareness has been introduced among the communities. In the context of floods, the process of urbanization has also led to an increase in the number of new residents who are unfamiliar with the vulnerability of the local land. This has led to the difficulty for people to prepare themselves for an out-of-ordinary risk and to decide how best to protect their lives and property at the time of disaster. Sato et al. (2001), in Ikeda (2006) mentioned that this trend tends to ''leave the disaster prevention initiatives to authorities or other organizations'' as residents wait for information from the authorities before

acting when a disaster occurs, and as an effect, the local communities has weakened their capacity to minimize the losses.

Regarding the facts above, it is no doubt that the communities really depend on authorities (local government). They perceive their safety as local government's responsibility and depend on the information provided by the local government. This gives the local government an essential role in communicating the urban flood risk information. The importance of the role of the government in risk information and education cannot be over-emphasized. The government should appropriately inform people so that they can take rational actions (Seo, 2006). For example, the history of open-information policy is short in Japan. Until recently, many landowners were against open risk information such as distributing hazard maps because risk information may lower the value of their properties. Also, both the government and public shared the same idea that the government could guarantee zero risk; hence open information gave the illusion of inconsistency.

Today, the policy of open information is widely accepted. In Japan, people can obtain risk-related information through various media upon demand. For instance, a web system called Participatory Flood Risk Communication Support System was developed for educational and information purposes (Seo, 2006). However, the argument whether the information should be open still goes on. Seo (2006) mentioned that many have stated that open information is not being capitalized, making others not to pay enough attention to the risk information in their daily lives. They feel it is ridiculous to prepare for a hazardous event that may come within 200 years. People always have had difficulty remembering natural disasters if they are not frequent (Hutington & MacDougall, 2002 in Seo, 2006). People in urban areas are especially unprepared for natural hazards because floods in megacities are less frequent due to the improved technology. Added to this, these people are not knowledgeable about the nature of their homelands because many of them are coming from the countryside (not natives of the city), and their residential time in the city tends to be short. Consequently, losses due to floods often become larger. The case example of Japan described that people were not well informed about the flood risks they were facing. For example, new people in new living environment are not informed about the current conditions of flood risk. Therefore, it is necessary that the local government contributes to the information dissemination about the flood risk. If urban communities know beforehand about the impacts, then they could take precautionary actions through flood risk reduction activities. The local government plays a major role in flood risk communication.

Risk communication has improved in many ways over the years, and there exist now well-established ground rules that communicators, at this respect, local government, must know and use instinctively as they communicate about various risks and hazards (Adler & Kranowitz, 2005). In the current perspective, by providing the public with information, risk communication becomes a two-way communication, which involves providing information, understanding people's perception of the risks, and developing solutions in partnership. As has been described by Shaw and Gupta (2009), information and communication management is the backbone of all the participatory processes involved in urban risk management. It is a cross cutting theme that touches each stage of the urban risk management process and is critical for ensuring that all stakeholders engaged in the activities operate in a coordinate, efficient, and effective manner. Information and communication management could "soften" the problems in the participatory process, and ensure collectivity. According to Takeuchi and Suzuki (2006), in obtaining effective flood risk management, risk communication between residents, local communities, and government agencies will be necessary. Therefore, the disaster prevention knowledge available to each of these groups should be improved. And usually, disaster prevention system has three major internal stakeholders. The first one is the government, the second is the community, and the third are the individual members of the community. Besides these, there are other stakeholders like civil society, academics, corporate sectors, media, and international agencies (Takeuchi & Shaw, 2010).

Referring to the above-mentioned statements, for having effective flood risk communication, local government should engage public and collaborate with them and other major stakeholders. Indeed, effective risk communication is a two-way process within participation seen as individuals' and community's democratic right (Adler & Kranowitz, 2005). It is strongly recommended that local government should engage public in a long-term coordinated dialogue using a variety of format, prior, during, and after the disaster, because information and communication management and its associated activities may be inbound with the four stages of disaster management cycle (Shaw & Gupta, 2009) (Fig. 2).

In terms of importance of understanding the community's interests, to effectively communicate the flood risk issues to a community, local government must first understand what issues are important to them. To reduce the flood risks, the government must make the decision between regulation and informed choice (Seo, 2006). In general, regulation is easier and a more risk-averse way. Land use regulation against flood, including retarding basins and building regulations, are direct ways for a society to

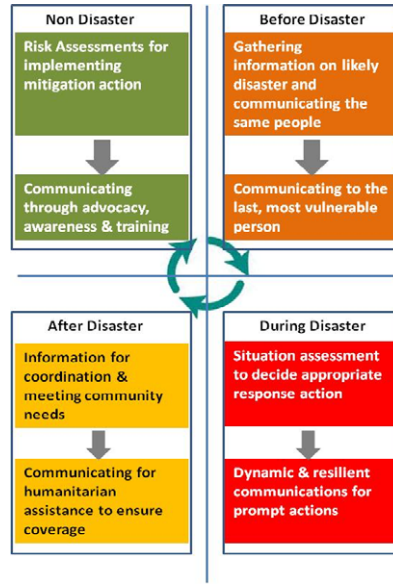

Fig. 2. Information and Communication Issues in Disaster Management Cycle. *Source:* Modified from Shaw and Gupta (2009).

avoid flood risk exposure. To keep a retarding basin in a city area is sometimes costly, but often less expensive than the cost of constructing structural measures. However, regulation is rigid compared with informed choice, and thus is not always supported by the public.

Seo (2006) also argued that informed choice is often better in terms of cost–benefit efficiency if the public appropriately perceives the risk. It is particularly efficient when the value system of the risk takers and that of policy makers is different. When the public and the policy makers are sharing the same value system, the public will take appropriate action, even without regulation, only if the public is informed.

DISCUSSION AND WAY FORWARD

Since disaster risks are essentially local, particularly flood in urban areas, their impacts are directly experienced at the local and community levels. Most of the flood reduction measures that could be carried out at the local and community levels are executing land use and urban planning;

environmental management; construction of embankments; setting up flood early warning system; and mobilizing community group level warning systems. All above examples show that without a body, agency, authorities, and institution who should authorize the actions, it will be meaningless. The local governments have the mandate, the legal aspect, and the umbrella for flood risk reduction measures. The local governments are at the top of the sphere to give services to the public and to protect public's social welfare from disasters. For public protection and building safe urban environment to live, local government should address the risks; in this case, the flood risks that will be/are faced by the community. It is the duty of local government to inform the public about the flood risks. Naturally, communication of those risks should be in line with certain guidelines, rules, and standard operation procedures to be able to convey crucial information and data to the community as well as to have proper and appropriate impacts of it (no/less casualties, damage, and loss). In order to achieve maximum impacts, reflected from case examples of urban floods around Asian cities, it is strongly recommended that local government communicates the risks through various stages of disaster management cycle, before, during, and after the flood. There is no doubt that local government has essential role in communicating the urban flood risks.

To date, the challenge of addressing urban floods and reducing urban flood vulnerability has become larger. The facts show that people are migrating from rural areas following urbanization and further expanding the city's territory, causing additional impacts on the living environment of the cities. Urbanization is occurring at such rapid pace that cities are not able or not equipped to manage the present concerns. Since urban communities are dependent upon the infrastructure and essential services, cities' governments need to be aware of current and future potential of climate-related disaster risks, such as flood that threaten to exacerbate existing vulnerabilities and further entrench city development disparities. Therefore, there is a strong need to build an urban resilience. The concept of urban resilience in the context of climate-related disasters is a holistic approach that measures the strength and capacity of a city in the form of physical, social, economic, institutional, and natural dimensions. This concept is recognized as a Climate Disaster Resilience Initiative (CDRI) and introduced by Kyoto University. This initiative starts at resilience mapping of the dimensions followed by creating until the implementation of the action plan, which includes determining the options for action to address the key issues; assigning roles and responsibilities; and allocating the budget. It requires organizing a team that goes beyond cross city sectors and working units, provides a platform for dialogue, and involves multi-stakeholders. Since risk communication as

defined in the earlier section is an interactive process of exchanging information and opinions between stakeholders regarding the nature and associated risks of a hazard on community and the appropriate responses to minimize the risk, the CDRI, in fact, is the process of the risk communication itself. It is a challenging initiative for the city's authorities as well as for urban communities in enhancing the city's resilience.

From case examples around Asian cities, it can be said that floods received little attention because responses at the city level were predominantly passive and highly dependent on the usage of ''strong'' solutions such as urban defenses and increase in the capacity of flood prevention structural facilities. Major stagnations could then be identified that would hamper the adoption and effectiveness of flood risk management from the urban planning practices perspective, which are lack of understanding of current and future urban flood risks and its implications at the city scale; lack of long-term planning (if it exists, it is poorly integrated as well as lacks comprehensive planning); and last but not least, there exists simply not enough control or monitoring and evaluation measurement about the roles of local authorities due to the ''conservative'' (old structure) nature of the building sector. It recognizes that the approaches omit important ways of dealing with floods proactively at the city level. It should be based on building in bottom-up responses, which will reduce impacts and enhance urban floods recovery. And to bridge these gaps, one of the many strategic options that should be applied is communication by local authorities.

For the different types of urban floods, different types of risk information and risk communication strategies need to be appraised; hence, the involved stakeholders also have different roles in urban flood risk communication process. For example, the public should know and be able to identify the potential inundation zones as well as the corresponding flood probabilities; people should know where to go during the flood by finding ''flood-free'' zones; if people are already caught in the middle of high inundated areas, the consequences should already be known individually and sector wise (resilience actions and basic provision such as food supply by private sectors); and when it starts to rain, a certain water level should be agreed upon by the communities and the authorities to begin with reduction measures such as taking precautionary actions and evacuation.

All these could be done beforehand and losses reduced by local governments by engaging other stakeholders, involving public participation, and employing communication as their strategic tool. (Overview of the proposed idea is summarized in Fig. 3.) Therefore, such casualties, damages, and huge losses due to urban floods in Mumbai, Jakarta, etc. should never

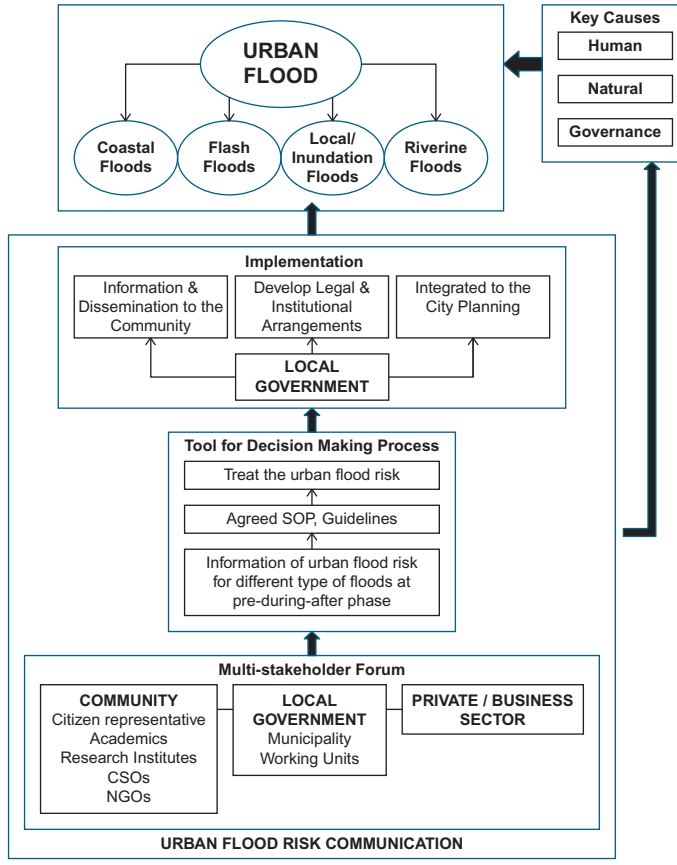

Fig. 3. Diagram of Urban Flood Risk Communication Framework for Local Government.

occur again. Urban flood risk communication done by local government is one of the key factors that is needed in obtaining clear framework to enhance and assess the flood resilience of urban areas and communities.

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CHAPTER 13

ROLES OF CIVIL SOCIETY IN CLIMATE AND DISASTER RESILIENCE OF CITIES AND LOCAL GOVERNMENTS

Takako Izumi and Rajib Shaw

INTRODUCTION

During the period of 2000–2009, a record 402 climate-related disasters occurred in the Southeast Asia region, and the number of geophysical disasters was 61 according to the International Disaster Database by Center for Research on the Epidemiology (CRED). The number of climate-related disasters is much higher than that of geophysical disasters, but due to small or medium scale of the events, attention and assistance to most of them have been limited. Although many people are affected by these disasters every year, in many cases, they do not have sufficient idea and knowledge on preparedness and disaster risk reduction (DRR).

The Hyogo Framework for Action (HFA) adopted at the United Nations World Conference on Disaster Reduction (WCDR) clearly projected the direction and priorities of DRR efforts during the next decade. It identified five priorities for actions: (1) make DRR a priority, (2) know the risks and take action, (3) build understanding and awareness, (4) reduce risks, and (5) be prepared and ready to act (UNISDR, 2005). WCDR and the Indian Ocean

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Tsunami in 2004 put a significant influence to trigger a change in the trend of typical disaster management attitude that pays more attention to disaster response. (Thomalla, Downing, Spanger-Siegfried, Han, & Rockstrom, 2006). Further concerted efforts and mechanism are needed to reverse the trend and to make the paradigm shift to the predisaster phase. The major disaster management approach, which was response and recovery oriented, was not sufficient to save people's lives from extreme events. The dialogue and initiatives for DRR are becoming more and more active among governments, international and regional organizations, and civil society organizations (CSOs) and donor communities. Despite the efforts made so far by various actors for disaster management, the damage and impacts by disasters in the last few years were very severe, including Cyclone Sidar in Bangladesh, Cyclone Nargis in Myanmar, and the earthquakes in China, Haiti, and Chile. This may imply the need of a new and additional approach to DRR. First, DRR needs to be discussed from various perspectives such as climate change, increase of urban risks, poverty, and cross-cutting issues. The United Nations Global Assessment Report on Disaster Risk Reduction stated that current progress in implementing the HFA is failing to address the underlying risk drivers such as vulnerable rural livelihoods, poor urban governance, and declining ecosystems that shape the relationship between disaster risk and poverty (UNISDR, 2009).

Second, the involvement of various stakeholders from international to local level, in particular at local and community levels, in DRR is a key to strengthen DRR capacity and tackle root causes and risks to disasters. The Global Assessment Report showed "A 20-Plan to reduce risk." One of the plans recommended is to promote a culture of planning and implementation of DRR that builds on government–civil society partnership and cooperation and is supportive of local initiatives in order to dramatically reduce the cost of risk reduction, ensure local acceptance, and build social capital. It is also recognized that local stakeholders including CSOs and local governments have major responsibilities for disaster management including immediate emergency response and disaster prevention, and they are the first responders to emergencies along with communities and neighbors. It is also at the local level that development planning is expected to take place and where DRR must be first integrated into development process (UNISDR, 2010; Benson, Twigg, & Myers, 2001). However, the participation of local stakeholders in the main conferences and meetings to discuss the future DRR strategy is extremely limited. It implies that the roles of CSOs and local governments in DRR have not been sufficiently acknowledged and their opportunities to obtain the information and knowledge for strengthening their capacity in

DRR are also a minimum. A new support mechanism to and among local stakeholders who must respond to many small- and medium-scale climate-related disasters by themselves is urgently needed to develop and strengthen the DRR capacity at local level to enable local stakeholders to respond to disasters and initiate the DRR efforts without relying on the support by higher levels.

This chapter focuses on the contribution and roles of CSOs in strengthening capacity of local government in climate and disaster resilience. First, it is reviewed how CSOs develop their capacities by taking case studies of a regional CSO network. Second, after the CSOs gained knowledge and skills in disaster management through the network, it is reviewed how the experiences contributed to enhance the capacity of local governments and the collaboration were expanded further.

SUPPORT MECHANISM TO LOCAL STAKEHOLDERS

Compared to local governments, national governments as well as international and regional organizations have more opportunities to explore the possibility of various supports in coordination and knowledge development. A number of international and regional conferences and dialogues on DRR have been organized all over the world in particular after WCDR and the Indian Ocean Tsunami, inviting high-level national government officials, UN agencies, international and regional organizations, and CSOs. Since 2006, the Asian Ministerial Conference on DRR (AMCDRR) has been organized every year to discuss the issues and challenges inviting different stakeholders. The Global Platform for DRR that is the global forum for accelerating world-wide momentum on DRR takes place every 2 years since 2007. As the primary gathering for the world's disaster risk community, it brings together governments, UN, international and regional organizations and institutions, CSOs, scientific/academic institutions, and the private sector. The United Nations International Strategy for Disaster Reduction (UNISDR) is the UN entity responsible for coordinating the organization of the Global Platform and supporting the regional platforms and Ministerial meetings on DRR. The major targets of these initiatives are at international and national levels. However, not many local stakeholders are given learning and direct networking opportunities with others such as international and regional organizations, donor agencies, and academics. This situation limits to enhance their capacity

and funding opportunities, although they have an immense role in disaster management.

WCDR became a milestone among disaster management stakeholders in a sense that it shared a clear blueprint and strategy in DRR for the next 10 years. HFA was adapted by 168 countries and it became an objective and guideline for all the DRR stakeholders in achieving community resilience to disasters. However, this was still a milestone mainly for the actors at international, regional, and national levels. The idea was not cascaded down to local and community levels. For instance, in a survey conducted in 2010 with a target of 42 local government officials who have a role in disaster management efforts in Johor State in Malaysia, only 5 officials answered that they had heard about HFA at the time of the survey. The Johor State is considered the most disaster-prone area in Malaysia in the last few years. From this survey, it is observed that the basic information and knowledge on the HFA priorities and necessary tasks in DRR have not been acknowledged sufficiently at local level.

The same analysis can be made by the result of the Report of Views from the Frontline issued by the Global Network of Civil Society Organizations for DRR (GNDR), the average scores at local level (local government, CSOs, and community representatives) for the HFA progress under each priority are lower than the average reported in the Global Assessment Report conducted at national level (Table 1).

In order to improve the situation, the question remains as who will provide necessary support to local stakeholders. In terms of capacity development for

Table 1. Average Scores for HFA Progress at National and Local Levels.

HFA Priority	Average Score at National Level (Global Assessment Report)	Average Score at Local Level (Views from the Frontline)
1. Governance	3.3	2.36
2. Risk assessment, monitoring, and warning	3.1	2.36
3. Knowledge and education	2.9	2.37
4. Underlying risk factors	2.9	2.41
5. Disaster preparedness and response	3.2	2.42

Source: GNDR (2009).

CSOs, a network among CSOs plays an important role in strengthening their capacity. Through a network, CSOs can have more opportunities of information exchange and mutual learning. For example, the Asian Disaster Reduction and Response Network (ADRRN) was established in 2002 in particular to contribute to the capacity development of national and local CSOs in Asia and enhance the coordination among the Asian CSOs in disaster management. For the capacity development of local governments, three possible mechanisms to receive supports are identified (Fig. 1).

As indicated in the model (a) in Fig. 1, the capacity of local governments can be strengthened by the guidance, instruction, and necessary budget allocation by national government. However, it is possible only if national government has a strong commitment and leadership in DRR within the country. An initiative to fill in the gap has already been taken at international level as indicated in the model (b). UNISDR established "Local Government Alliance for DRR" in 2008 in order to facilitate knowledge and information sharing on DRR between north and south, south and south, and urban and rural local governments, to raise awareness and encourage the active role of local and regional authorities in mainstreaming DRR; to improve local governments'

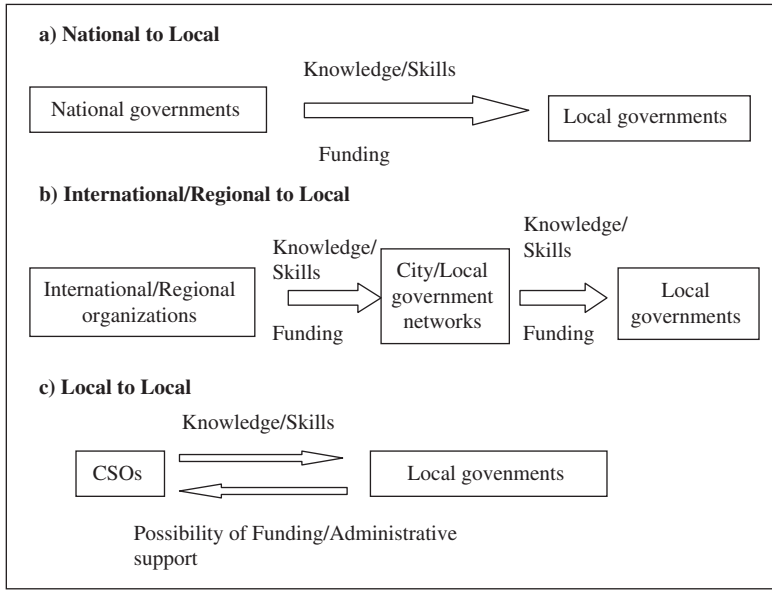

Fig. 1. Support Mechanism to Local Governments.

understanding of central governments, particularly with respect to DRR strategies and implementation; and to ensure the coordination of DRR actions among relevant stakeholders, to improve the efficiency of use of resources and avoid duplication of activities (UNISDR, 2008). More networks are formed such as Local Authorities Confronting Disasters and Emergencies (LACDE) and United Cities and Local Government (UCLG). However, not all the cities and local governments can be involved in these networks and the coverage is still very limited mainly due to financial constraints and tremendous numbers of cities.

As indicated in the model (c) in Fig. 1, CSOs have a role to play to provide support to local governments in technical matters. Under the current situation that the attention and support to local governments from higher levels for climate-related disaster management is not sufficient, the role of CSOs and collaboration among local stakeholders in their capacity development is a key. Once local government understands the importance of the DRR interventions, the possibilities of funding support to CSOs from local governments is increased. Some initiatives for developing capacity of local governments have already been taken by CSOs in their DRR projects. In the following section, the definition of CSOs and how it is possible for CSOs to develop their own capacities before sharing the information with local authorities are reviewed in particular through a case of the Asian CSO network.

CAPACITY DEVELOPMENT AMONG CSOS

Definition of CSOs and Their Roles in Disaster Management

The term CSO includes the nongovernment organizations (NGOs) engaged in development activities, but NGOs are one of many types of organizations that constitute civil society. Civil society constitutes a vast array of associations, including trade unions, professional associations, religious groups, cultural and sports groups, traditional associations, farmers' associations, community-based organizations, women's organizations, environmental groups, faith-based organizations, labor unions, and the nonprofit media among others, many of which are informal organizations that are not registered (Table 2). Despite the huge variety of different types of organizations, most of the funding from international sources for service provision is channeled through NGOs. Although it is important to keep the terms CSO and NGO analytically distinct, in practice the majority of CSOs involved in service provision are NGOs

Table 2. Major Categories of CSOs.

Nonregistered Informal Organization	Registered Organization/ Service Provider
Trade union	International NGO
Religious group	National NGO
Cultural/sports group	Local NGO
Traditional association	
Women's organization	
Environmental group	
Farmers' association	
Community-based organization	
Professional association	
Faith-based organization	
Labor union	
Nonprofit media	

(Advisory Group on CSO and Aid Effectiveness, 2007; Clayton, Oakley, & Taylor, 2000). CSOs that do not belong to NGOs often involve in humanitarian and development works as partners of NGOs.

Recently, instead of using the term "NGO", the term "CSO" is often being used as a wider meaning of practitioners in disaster management at local level. This could imply that the role of not only NGOs but also other CSOs such as women's organizations and religious groups who had not been seen as major actors in disaster management has greatly increased. NGOs could play a role of channeling funds received from international organizations and donor agencies for other CSOs and of being trainers on technical subjects for them.

The initiative of establishing GNDR was taken in 2006 by UNISDR. At that time, UNISDR intended to form the Global Network of NGOs for DRR with the aim of addressing DRR issues at subnational and community levels. However, the name of the Network was modified as "Global Network of CSOs for DRR (GNDR)" in 2008 to maximize CSOs to support the building of resilient communities and nations (UNISDR, 2008). The involvement of CSOs in disaster management and climate change adaptation (CCA) efforts is more and more emphasized. Both the scale and the profile of CSO activities have increased greatly in the past decade (Clayton et al., 2000). UNISDR suggested 22 tasks that address a primary area of effort for implementing DRR under the HFA. Out of a set of 22 suggested tasks, the involvement of CSOs is encouraged in 18 tasks. Primary responsibility for implementation rests with states, but the collaboration and cooperation among all stakeholders, including NGOs will be crucial in order to improve the resilience of communities (UNISDR, 2007).

CSOs are often in a better position to identify real needs and priorities, efficiency, and rapidness to emergency response and indigenous knowledge. Because community-based activities (and community-based organizations) are deeply rooted in the society and culture of an area, they enable people to express their real needs and priorities, allowing problems to be defined correctly and responsive measures to be designed and implemented (Shaw, 2009). CSOs participate in disaster management possibly in two ways: the first is as a trainer for other CSOs and local governments and a program implementing partner. This is their "internal" role. However, without involvement of local governments, CSOs' work will not be sustainable and not be expanded further. This is why the CSOs' role of capacity development of local governments is so important to secure their understanding and support to the CSOs' DRR efforts. The case study on the capacity development of local governments by CSOs is included later in this chapter.

The second role is as an advocator of needs and gaps at local level and to bring them to international, regional, and national levels. This is their "external" role. Externally, CSOs have a role to address local voices to higher levels to improve the situation. For this task, the role of networks and platforms is significant. For instance, there is a CSO network at international level. The report developed by GNDR on the survey of the HFA progress conducted by a CSO in each country was shared at the Global Platform for DRR in Geneva and emphasized that the DRR capacity was still limited at local level compared to national level (GNDR, 2009).

Evolution and Role of Regional CSO Network

A CSO Network can be a platform for capacity development of national and local CSOs. Networks are best known for the capacities that they attempt to build in technical areas such as the creation and dissemination of best practices, improved interventions and approaches, and project/program design (Liebler & Ferri, 2004; Abelson, 2003). The ADRRN consists of 34 members from 13 countries (ADRRN website, www.adrrn.net). ADRRN was formed in February 2002 in Kobe, Japan, when "Regional Workshop on Networking and Collaboration among Asian NGOs in Disaster Reduction and Response" was organized by the UN Office for the Coordination of Humanitarian Affairs (UNOCHA) Kobe office and the Asian Disaster Reduction Center (ADRC). The participated NGOs agreed on the need for an Asian network of NGOs for disaster reduction and response in Asia to increase the efficiency and effectiveness of disaster

reduction and response activities, especially at the local level. NGOs at local level are most familiar with the hazards, languages, customs, and the environment at the local level, and possess a wealth of experiences in disaster reduction and response in the region. ADRRN became the first NGO Network that targets entire Asia (ADRC, 2002).

At the time of establishment of ADRRN, the term CSO was not as popular as at present and not many activities by CSOs, except NGOs in humanitarian and development works, were acknowledged. Thus, the target of the Network was only NGOs. However, following the increase in the involvement of other CSOs, not only the NGOs, in humanitarian assistance, the Network expanded the membership to entire CSOs as Associate Members and it became a Network for CSOs. However, during the first few years, the Network did not have any concrete activities mainly due to lack of funding and lack of clear picture/ideas on the role and direction of the Network, as well as because the member's commitment was also not as strong as at present. At least the first 2 years were challenging for ADRRN without any concrete outcomes, except for the website development. After nearly 2 years since the first meeting in 2002, ADRRN finally managed to hold a core group meeting in December 2003 in Kobe, Japan, to discuss the future plan and activities to be performed by ADRRN. The core group meetings were also held in 2003 and 2004 (Fig. 2). Due to the budget constraints, it was only in 2005 that the Network was able to organize the General Assembly with support from an international donor agency. The continuous support by donor agency, UN agency, and regional organization was one of the strongest reasons that the Network made progress.

The General Assembly has been regularized every year since 2005. This made possible to build a strong tie and partnership among all the members, and at the same time, this also provided a training session on specific topics such as accountability and organizational capacity development by inviting international facilitators and speakers. Since 2008, ADRRN has received funding support from another international donor agency. Because of this funding support, the Network became more active with the projects such as organization of a regional workshop and national trainings/workshops in four countries. Through these events, the member organizations gained knowledge on a new topic "CCA and DRR" and some of them initiated new programs based on the skills that they learned. The contribution of the Network to advocacy was also a major achievement. In the last few years, the acknowledgment to ADRRN was increased. The Network was invited to send a representative to Global Platform, the AMCDRR, and UNISDR Asian Partnership. These opportunities made possible that ADRRN

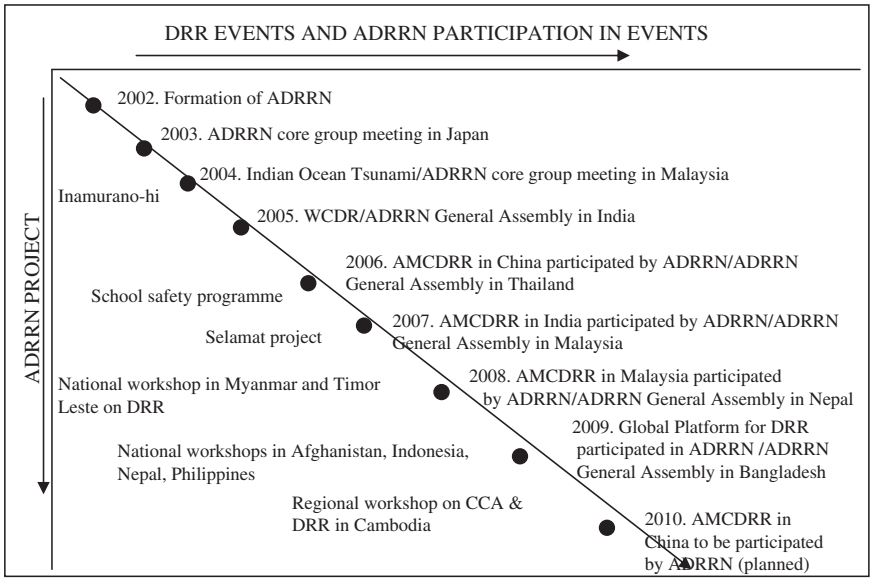

Fig. 2. Major Milestones of ADRRN's History.

addressed a voice from Asia, Pacific, and local level to international and regional levels. ADRRN is a successful case of a CSO Network in a sense that the number of members and the amount of funding increased, and based on that, the cooperative projects among the members were implemented. The projects included development of disaster preparedness brochures based on the Japanese folklore (Inamurano-hi) in eight languages, implementation of School Safety programs in three countries (Care Society, SEEDS India, and MERCY Malaysia), and the Selamat project (Building Resilience to Tsunamis in the Indian Ocean) in India, Sri Lanka, Maldives, and Indonesia. The Network provided an opportunity to the members to gain the new knowledge and encouraged them to have a holistic approach to disaster management by putting an equal attention to both post- and predisaster phases. Through these experiences, the members learned the effectiveness of preparedness and found out that the local stakeholders have not possessed yet enough ability to promote the preparedness at local level and need to improve their capacity first. Furthermore, the members realized that there were roles for them to play in project implementation and capacity development of local stakeholders.

In the next section, a case study of capacity development for CSOs by the ADRRN member in Indonesia is introduced. A CSO based in Yogyakarta gained DRR knowledge through the cooperative project with the ADRRN members and initiated the project to share the knowledge with other local stakeholders for their capacity development.

Capacity Development Process

Indonesia experienced almost all types of disasters, namely, geological, hydro-meteorological, and human made disasters. According to CRED, the total number of climate-related disasters that occurred in Indonesia in 2000–2009 is 90 and it is much higher than the number of geophysical disasters, i.e., 49. While geophysical disasters occur once a few years, climate-related disasters hit wide areas every year. The damage and impact by climate-related disasters are not that dramatic as by geophysical disasters. As such, media attention and coverage to climate-related disasters are not strong enough to make an influence on donors and international communities to offer assistance to the affected areas. While the support by international, regional, and even national levels cannot be expected, CSOs and local governments must have sufficient ability to deal and cope with these disasters without any external assistance.

Society for Health, Education, Environment and Peace (SHEEP), a CSO in Indonesia, joined ADRRN in 2007 and was involved in the project ''Building Resilience to Tsunamis in the Indian Ocean'' coordinated by ADRRN in 2007 and 2008. Based on the knowledge learned through the ADRRN activities, SHEEP aimed for sharing what they have learned and contributing to the DRR capacity development of other local stakeholders. SHEEP believed in the stronger need of DRR in Indonesia and of the active involvement of the Indonesian CSOs and local governments in the entire disaster management process. It is only CSOs and local governments who can identify and advocate the risks by unseen climate-related disasters and need of self-support to deal with such disasters. SHEEP started the project of DRR capacity development of CSOs in 2009, covering the west coast of Indonesia which include West Aceh, North Sumatera, Lampung, Bengkulu, Jakarta, West Java, Central Java, East Java, Bali, west Nusa Tenggara, and West Borneo. Other ADRRN members contributed to the project by participating in the workshops as speakers and facilitators. Seventeen CSOs from these areas participated in the project. The project consisted of two major activities: (a) DRR/CBDRM workshop and (b) experience-sharing

workshop and learning session on CCA. The participants developed an action plan during the DRR/CBDRM workshop, and within 3 months after the workshop, the participants were expected to implement the action plan.

At the experience-sharing workshop, 17 CSOs reported their experiences and DRR activities carried out. The activities by CSOs included having a discussion and dialogue with the communities to raise their awareness on DRR issues, organizing an internal training for their staff on DRR, and advocating support by local government to their DRR efforts. Some of them linked to their existing projects and added the DRR component into their current theme. Out of nine CSOs who completed their DRR project, six CSOs carried out the projects that aimed for strengthening community resilience to climate-related disasters, two to multihazards, and one to geophysical disasters. Climate-related disasters were major concerns to the participated CSOs due to their frequency and lack of attentions by higher levels (Fig. 3).

Furthermore, most of the CSOs addressed at the experience-sharing workshops the importance of the support by the local governments and it was agreed that all the 17 CSOs should actively involve in advocacy for encouraging the local governments to participate in their DRR activities. Based on the discussion and request at the workshop, SHEEP made a decision to initiate the capacity development project in 2010–2011 focusing on the local governments in Indonesia. The project also aims to provide a fora for both CSOs and local governments to explore and discuss together

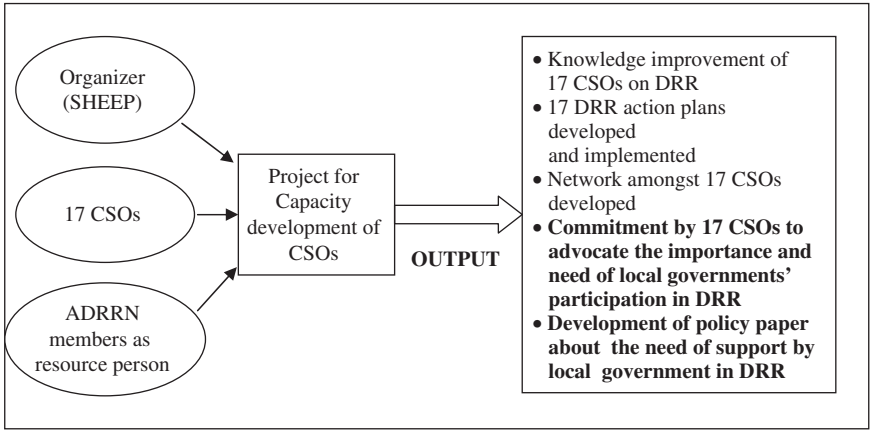

Fig. 3. Project for Capacity Development of CSOs in Indonesia by SHEEP.

the current issues, challenges, possible collaboration, and joint actions (SHEEP, 2009). This project conducted by SHEEP became a window of opportunity for the CSOs to understand the importance of collaboration with the local governments and to initiate dialogue, partnership, and collaboration with them. The following text is about the activity conducted by one of the 17 CSOs after the first workshop. It succeeded in establishing a contact with the local government and policy makers to have a dialogue and discuss the problem caused by floods every year along the river side.

Jaringan Masyarakat Sungai Juwana (JMS Pati) is a community-based organization. They learned about DRR and the importance of DRR measures to protect the lives and assets of the communities through the workshop conducted by SHEEP and prepared an action plan for developing the community resilience. The communities along the river have been suffering floods every year. The opportunity of participating in the SHEEP project gave them a strong foundation to take an initiative to raise DRR awareness of people along the river. The group established a network "Jampi Sawan" (JS) of the community alert group represented by peasant groups, fishermen group, and the local leaders. JS was very active in the awareness raising activities on DRR through regular meetings and discussions with the village leaders on the risks of living along the river side. An assessment on the condition of the Juwana River that causes flood every year was conducted by the members and a strong need and importance of rehabilitating the river system and adapting DRR measures was recommended to the local government. The meetings among JS, the local house, and the local disaster management agency were held in September and October 2009. The discussion among them is still continued and it is in the process of developing a policy for environmental management by the local government of Pati District in Central Java (SHEEP, 2010). Until JMS Pati took an action, no one had raised the issue along the river and no measures had been taken by the local governments. CSOs have a critical role to address the issue to local governments and to suggest a measure and tool for reducing a particular risk.

COLLABORATION AT LOCAL LEVEL

Collaboration between CSO and Local Government

As the 17 CSOs participated in the SHEEP's project, many CSOs realized the importance of the support by local governments through their DRR

activities and projects. MERCY Malaysia that is an international NGO had the same experience, and they also learned the value of the collaboration with the local governments and need of capacity development of the governments through their flood response activity, and it became a trigger point to initiate the DRR project and department (MERCY Malaysia, 2009). Disaster experiences in Malaysia are not significant. According to CRED, from 2000 to 2009, the number of disasters that hit Malaysia is 34, which is 6.6% of the total number in Southeast Asia. However, the damage by climate-related disasters, in particular floods, is increasing. Most of the floods causing tremendous damage occurred within the last 10 years. Out of the top 10 floods by the total affected number, 8 floods occurred in 2000–2010. However, except the severe flood in 2006, the attention by the national government to the small-scale disasters is limited; rather it is expected that the relief efforts are managed at local level. MERCY Malaysia started putting more attention on the predisaster phase after the Indian Ocean Tsunami in 2004. However, there were no major DRR activities until later 2007 as the DRR concept was new to them at that time and their DRR capacity was still weak. Through the relief efforts in 2006 and 2007, MERCY Malaysia clearly realized the importance of preparedness among the communities and of working closely with the local government for an effective disaster relief effort. In order to gain the DRR knowledge, MERCY Malaysia requested support from the ADRRN members who have been already active in the DRR field. MERCY Malaysia sent the staff to SEEDS India for 2 weeks to study the tools and activities of their school safety programs. Since their first school preparedness activity in November 2007, MERCY Malaysia became the first organization that initiated the awareness programs for the school children and teachers in Malaysia in cooperation with Ministry of Education.

In 2008, a Community-based Disaster Preparedness Program (CBDPP) activity that targeted the flood-prone areas in Johor started and aimed for the capacity development of both communities and local governments. The program covered three districts in Johor and consisted of four steps: (a) sensitization seminar for local authorities, (b) town watching workshop for local authorities and community, (c) implementation of CBDPP, and (d) information sharing seminar (MERCY Malaysia, 2009).

The communities that learned DRR through the workshop were expected to come up with an idea of their own preparedness project to floods and to implement it within the next 3 months. Their priorities of the activities were putting up signage of evacuation routes, conducting the community first-aid training and school preparedness program, and developing a brochure on

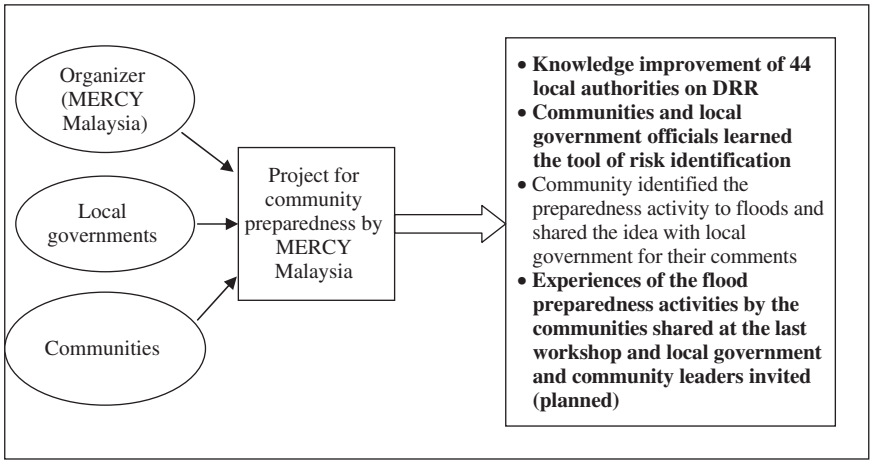

Fig. 4. Project for Community Preparedness by MERCY Malaysia.

DRR and local knowledge to protect themselves. These activities were planned and led by the community with support from the local governments and MERCY Malaysia. This project was designed for the local authorities to engage in all the steps and they were requested to provide their inputs and share their views in each step. Through this project, the awareness of both local authorities and communities to climate-related disasters was raised and the DRR activities could be sustained with the ownership and leadership of these local stakeholders (Fig. 4).

Expansion of Collaboration at Local Level

The cooperation at local levels is not limited only to among CSOs and local governments. By including other stakeholders such as academics and private sectors in the existing collaboration and partnership, a different type of DRR project is developed and a new perspective and approach is adapted into the project. In particular, climate change and how to tackle frequent and unseen climate-related disasters are a big concern among CSOs. The issue of climate change is still new to CSOs and local governments. CSOs have more and more interests in the program of CCA and mainstream the CCA elements in the current DRR programs; however, the weakness of CSOs is data and information correction. Also, their approach is often

needs-based and short-term. Their project planning focuses more on the problems and issues that are already happening. The attention does not go to expected damage and impacts in the future estimated by scientific data. For the purpose of information and data correction and securing technical advice and inputs, it is an option for CSOs and local governments to establish a partnership with academics. The partnership among CSOs, local governments, and academics is a key to develop in particular climate-related disaster projects. The project can be designed to cope with climate risks that may happen in the future. In Malaysia, there is a model of the collaboration of the three parties. The participated CSOs play a role in raising the need of the information for CSOs and local governments on climate change and how the issue can have a linkage with DRR.

In Malaysia, the network called the Malaysian Network for Research on Climate, Environment and Development (MyCLIMATE) was established (Fig. 3). The Secretariat of MyCLIMATE is hosted by the Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM) and supported by the Ministry of Natural Resources and Environment Malaysia. MyCLIMATE is a network of researchers from various universities, government agencies, and organizations dedicated to conducting research on climate change in support of sustainable development. Through its members, MyCLIMATE provides research support to the National Focal Point for UNFCCC and the Cabinet Committee on Climate Change in climate change research activities at national, state, and local levels. It is also a network of individuals and organizations from various universities, government agencies, and institutions interested in climate change issues to support sustainable development (LESTARI, 2009). The Network expanded a dialogue and collaboration with private sectors and CSOs. In March 2010, a dialogue on "MyCLIMATE-NGO: Mobilizing Communities and Industries to Address Climate Change" was organized by LESTARI, inviting Malaysian Climate Change Group (MCCG), Malaysian International Chamber of Commerce and Industry (MICCI), and MERCY Malaysia. The opportunity created a forum of learning the issue of climate change and discussing the role of each party. The challenge was raised by the representative of a CSO in the dialogue that the information of climate change on the cause and possible future risks was not sufficient and the existing information and terms used in it were not friendly to all the audience and readers, although Malaysia is prone to climate-related disasters and should have solid knowledge on the impact of these disaster on their lives (Fig. 5).

Because of lack of the information, the knowledge on the serious impacts including the change of patterns, scales, and frequency of hazards on the

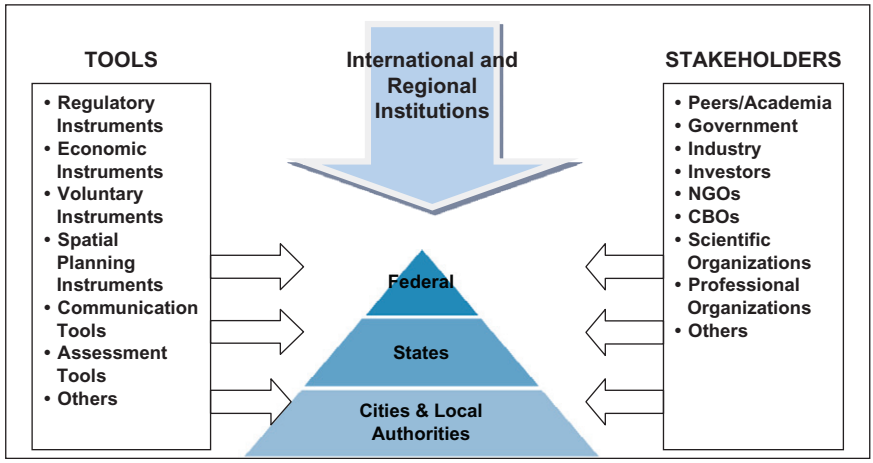

Fig. 5. Tools and Stakeholders in MyCLIMATE. *Source:* Joy Jacquerine Pereira, presentation at dialogue on "MyClimate: Mobilizing Communities and Industries to Address Climate Change" LESTARI-UKM, 2010.

communities' actual life are not communicated properly and it is difficult for the local governments to make the strategy to deal with the issues. As the result of the discussion, it was agreed that a brochure of "Climate Change Adaptation and DRR" in the Malaysian context that targets CSOs and local governments would be developed among the Network. CSOs can distribute the brochure and information to the local governments at their project sites. In this case, the CSO managed to raise the concern of lacking the information in particular at local level on CCA and DRR and proposed the cooperative activity, which developed the material on the issues that could contribute to raising awareness of local governments on CCA and DRR. With the reliable information and data, it is easier to convince local governments for work on CCA and DRR together.

Another example is the collaboration among academics and local governments; however, there is a great potential for CSOs to involve in the program as a project implementing partner in the future. The International Environment and Disaster Management (IEDM) Laboratory of Kyoto University Graduate School of Global Environmental Studies, along with its partner organizations including CITYNET and UNISDR, has initiated the Climate and Disaster Resilience Initiative (CDRI) to measure the existing level of climate disaster resilience of the targeted areas

in five resilience-based dimensions: natural, physical, social, economic, and institutional. The whole process of CDRI is to make city managers and practitioners aware of the existing and future city risk for climate-related disasters (Shaw & IEDM Team, 2009).

The next step for the local governments that were aware of the major climate risks in their cities is to make a strategic plan to reduce the identified risks and to take an action to improve the situation with projects. CSOs can play a great role to carry out various activities as a partner to governments to supplement the capacity of local government in project management. CDRI has a great potential to expand a framework of collaboration among different stakeholders at local level.

CONCLUSION

It needs to be greatly emphasized that frequency and damage by climate-related disasters are remarkable all over the world, and because of the influence of climate change, the situation may get worse. However, most of these disasters do not receive sufficient support due to lack of a significant damage by a single event. The one who can raise the issue and seek the necessary support is only CSO. In order to carry out the DRR projects, the support by local governments is indispensable. CSOs work to develop the capacity of local governments and as implementing partners. In particular, for climate and disaster resilience in local governments, CSOs possess the following major roles:

(a) to address needs of support to unseen disasters such as small-scale climate-related disasters that occur every year – HFA priority 2;
(b) to raise awareness of and increase the capacity of local governments as well as CSOs on the issues of climate change, its impact, and DRR – HFA priority 3;
(c) to become a implementing partner of local governments to materialize their strategic plan to climate-related disasters – CDRI Physical and Social;
(d) to identify additional support required in managing climate-related disasters by other stakeholders such as academics and expand the existing collaboration into wider partnership – CDRI Institutional.

These roles, at the same time, support in achieving the HFA priorities and improving the vulnerability identified by the CDRI project. It implies that CSOs can have a significant influence on the success and progress of building community resilience.

ACKNOWLEDGMENTS

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CHAPTER 14

BEYOND RESILIENCE MAPPING

Rajib Shaw and Anshu Sharma

CONTEXT

Over years, the concept of dealing with urban risk has changed. While in 1970s urbanization was equal to industrialization and physical infrastructure development, 1980s focused on sustainable development and urban growth. In 1990s, new concept of eco-city and resilient cities came into practice, and in 2000, urban ecosystem concept became more popular. There are possibly two or three key issues that can be incurred from this evolution process: first, urban issues are becoming complex and urban boundaries extending beyond the traditional city or administrative boundaries. For resources (natural, food, human, energy, water), cities need to depend more on rural areas. Urban–rural linkage issues are getting increasing importance. Second, while dealing with the urban problems, traditional physical and economic approaches have limitations in solving this issue; rather, more ecosystem-based approach or the environment disaster interface needs to be focused. Third, due to climatic changes, urban areas are increasingly becoming more fragile, and the deep impacts are on the poor and vulnerable communities living in the informal settlements.

Shocks and stress issues have been described in the first chapter of this book (by Sharma, Surjan, & Shaw, 2011). While, for natural reasons, the shocks get increasing attention due to their visible nature, the stresses, which are slow and deep rooted, get less attention. Often, the water stresses, heat waves, or slow impacts of sea level rise affect the low-lying coastal

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communities, but possibly do not become the newspaper headlines in most cases. Many of the coastal cities have large amount of fisherman population, whose livelihoods are at stake due to a complex function of human-induced and natural changes. Climate projections talk about the sea level rise at far future and at the regional level. It is often stated that there will be an increase in sea level by 30 cm or 50 cm by 2070 or 2100 in the southern part of country or region. This piece of information is quite confusing for the city leader or decision makers. While the regional projections pose a threat to the region, where the city is located, the projections do not talk about the specific impacts on the city boundaries. Also, the city decision makers have specific terms of 3 or 5 years cycle. So, the time and space issues are key obstacles of the climate scenario. It is required to have more city-specific scenario, as well as projections for the near future. It is understandable that the downscaling of climate scenario often poses threat to the uncertainty level. Precise climate scenario needs time, data, and resources, and very few developing countries can afford to have precise and near future downscaling of climate scenario. Therefore, the adaptation decisions become rather ad hoc and uncertain.

CHARACTERISTICS OF CDRI

Keeping these challenges in mind, the Climate and Disaster Resilience Initiative (CDRI) is a unique approach that takes into account the current city's risk and makes an assessment of the city services and systems. CDRI is a balanced mix of qualitative and quantitative approaches. It consists of a baseline assessment that is embedded in an overall initiative to make urban areas more resilient to climate-related disasters. The result of the baseline assessment is a mapping out of the strengths and weaknesses of a particular urban area; furthermore, cross-sectoral analyses allow drawing linkages between different dimensions, parameters, and variables in the form of correlation coefficients. Once the resilience of all the sectors is identified, the process of addressing potential deficits, in one or the other sector, in the form of participative action planning begins. The strong character of the CDRI to involve the local government in all the presented studies highlights the importance of this institutional body to effectively develop, apply, and implement disaster risk reduction (DRR) measures for making cities more resilient to climate-related disasters.

The other approach mentioned in the book is the linkage of CDRI with the HFA (Hyogo Framework for Action: 2005–2015). HFA is regarded as a

comprehensive tool to address the DRR issues holistically. The framework is agreed by experts in the field, and is approved by the country governments. The fascinating part of HFA is that it is possibly the first measurable tool for risk reduction measures with specific targets and indicators. Five priority areas focus on five key pillars of risk reduction approaches. While the first 5 years of the HFA focused on the national level implementation, next 5 year focus on the local level implementation. Through the process of training and capacity building of the local governments (refer to Chapter 7 by Matsuoka & Shaw, 2011, and Chapter 10 by Wataya, 2011), there is an established link of HFA and CDRI. While 20 tasks are identified for HFA implementation, 25 parameters are identified for CDRI analysis. This 20×25 matrix (500 cells representing 500 specific actions) can be the guiding tool for the local governments to monitor their activities, and see the impacts of the programs.

The other characteristic of CDRI is its nonscale nature. CDRI can be used for city level as well as subcity (district or ward) level. The methodology can also be used for neighborhood level, depending on data availability. Thus, more the city has data points, more the CDRI results can be of higher

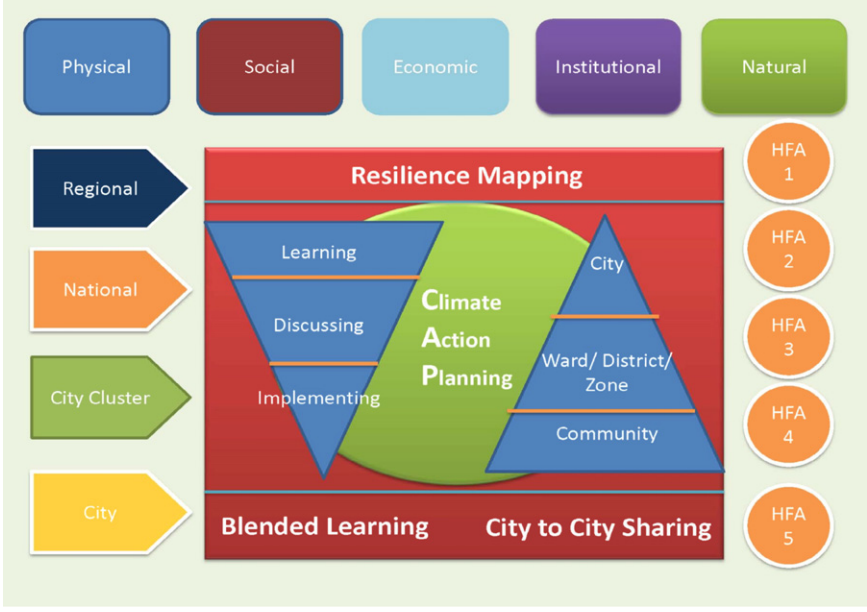

Fig. 1. CDRI Concept and Linkages.

resolution. The way the CDRI is developed, it can be used for the comparison of values of individual cities at the regional level, national level, or city cluster level. The cities can be classified according to their geographic locations, like coastal, mountain, river side, or arid area cities. The cities can also be classified based on their size, like small, medium, large, and megacities. The analysis results (overall CDRI values) and dimension-based (physical, social, economic, institutional, and natural) CDRI values can be used to characterize cities either based on their size or their geographic locations or both. Fig. 1 shows the overall concept of CDRI and its linkage to HFA. The figure also shows the city analysis process, from regional to individual cities and ultimately to the subcity levels.

UTILIZATION OF CDRI RESULTS

Table 1 shows the CDRI results of 36 cities from eight countries. As presented here, the CDRI can be a composite (overall index) as well as dimension-based index. These types of indexing can be used for identifying the most and the least resilient cities, and can be published periodically (once in 2 or 3 years). This is considered as a yardstick of resilience, and can be used as a monitoring indicator for cities. The other way of city analysis is the CDRI mapping, which shows city-specific analysis, and is linked to the specific city services (electricity, water supply, sanitation, housing etc.). The CDRI results also show the policy points for each city based on the CDRI dimensions and HFA priority actions. Thus, the CDRI–HFA linkage gives specific action opportunities for the cities.

As mentioned in the earlier chapters (Chapter 8 by Fernandez, Takeuchi, & Shaw, 2011; and Chapter 9 by Parashar, Sharma, & Shaw, 2011), action planning process is another important outcome of the CDRI. The action planning helps the cities in identifying their priority actions based on available resources. This is directly linked to the CDRI results. Specific training programs were designed for the city managers to enable the action planning process, and certain mechanism was developed to monitor the implementation of action planning. Further, these action plans can be linked to community-based planning, which will bring the actions to the community level, and identify community's potentials and needs to undertake specific actions.

Table 1. Climate and Disaster Resilience Index (CDRI).

Ranking	City Name	Country	Overall CDRI	Physical	Social	Economic	Institu-tional	Natural
1	Mandaluyong	Philippines	4.27	4.81	4.54	3.45	4.99	3.56
2	Navotas	Philippines	4.01	4.22	4.39	2.31	4.88	4.26
3	Suwon	South Korea	4.01	4.88	3.87	3.50	4.06	3.75
4	Makati	Philippines	3.99	4.48	4.25	3.59	4.62	3.00
5	Pasig	Philippines	3.96	4.71	4.31	3.76	4.10	2.94
6	Muntinlupa	Philippines	3.92	4.36	4.03	3.00	4.77	3.44
7	Manila	Philippines	3.90	4.60	4.81	3.65	3.34	3.08
8	Parañaque	Philippines	3.87	4.24	4.03	3.45	4.44	3.20
9	Hue	Vietnam	3.87	4.35	4.18	3.04	4.31	3.45
10	Port Blair	India	3.86	3.64	4.16	3.08	4.64	3.80
11	Valenzuela	Philippines	3.83	4.25	3.76	3.68	4.63	2.83
12	Nagpur	India	3.79	4.32	4.22	2.76	3.88	3.76
13	Las Piñas	Philippines	3.78	4.42	4.02	3.07	3.88	3.50
14	Taguig	Philippines	3.77	4.12	4.24	2.91	4.76	2.82
15	Caloocan	Philippines	3.75	4.76	3.65	2.57	4.80	2.98
16	Quezon City	Philippines	3.71	4.64	3.92	3.46	3.54	2.99
17	Marikina	Philippines	3.65	4.54	3.85	3.09	3.58	3.17
18	Pasay	Philippines	3.61	4.10	3.88	2.91	4.28	2.90
19	Kuala Lumpur	Malaysia	3.57	4.38	3.60	3.16	3.26	3.44
20	Pateros	Philippines	3.54	4.30	3.94	2.77	3.68	3.02
21	San Juan	Philippines	3.51	4.00	3.64	3.21	3.76	2.96
22	Kolkata	India	3.43	4.16	3.68	2.42	3.48	3.40
23	Guwahati	India	3.35	3.68	3.52	2.44	3.04	4.07
24	Chennai	India	3.29	2.92	4.08	3.06	3.56	2.83
25	Kanpur	India	3.15	3.36	3.16	2.52	3.60	3.12
26	Delhi	India	3.14	3.84	3.08	2.44	2.84	3.52
27	Colombo	Sri Lanka	3.14	3.91	3.23	2.77	2.57	3.20
28	Jaipur	India	3.13	4.04	3.32	2.44	2.76	3.08
29	Malabon	Philippines	3.02	3.43	2.96	2.56	3.35	2.82
30	Bhubaneshwar	India	2.92	3.24	2.60	2.60	2.93	3.24
31	Aizawl	India	2.91	3.16	4.24	2.24	2.36	2.56
32	Varanasi	India	2.86	2.99	3.14	2.52	2.58	3.08
33	Sukabumi	Indonesia	2.79	2.51	2.96	2.05	3.46	2.96
34	Shimla	India	2.76	3.44	3.44	2.52	2.20	2.19
35	Amritsar	India	2.71	3.36	2.60	2.40	2.08	3.12
36	Dhaka	Bangladesh	2.35	2.90	2.56	1.64	2.15	2.51

FUTURE VISION OF CDRI

CDRI is not just a tool to enhance city's resilience, but it is considered a process, which has three specific steps:

1. Assessment, which leads to a scenario of city level
2. Planning, which leads to the action plan of the cities
3. Implementation, which leads to the implementation of actions at city and community levels

The CDRI was developed and implemented by the university and research institutions, in close cooperation with the city governments. The ideal situation of future implementation of CDRI is to develop the linkage of city government–local university–local NGO network. There are regional networks existing in the Asian region. CITYNET runs the city government network, ADRRN (Asian Disaster Reduction and Response Network) runs the local NGO network, and AUEDM (Asian University Network of Environment and Disaster Management) runs the university network. All these networks have unique characteristics and resources. When seen at the city level, if the city government gets technical support from local universities, and implementation support from local NGOs, it can create a sustainable system for implementing city-specific actions. The networks can help in sharing the lessons and disseminating the experiences across cities, and thus identify good practices for training and capacity building.

The success of CDRI at the city level depends on the formalization of action plan, and to get it passed in the city senate to enable the use of city budget. As mentioned earlier, mainstreaming risk reduction measures depends on how effectively the actions are linked to the city services, and how effectively the city budget is used to support some of the activities. This process does not take place overnight, it needs time for raising awareness of the city policy makers, socializing the action plan, and creating an enabling environment to ensure that the action plan is approved by the city senate or council. For this, local stakeholders (universities and NGOs) play important roles. Therefore, CDRI is not just a tool, but it is a process to create an enabling environment for implementing actions at city levels, as well as community level.

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